SCRIPPS
INSTITUTION OF
OCEANOGRAPHY

Meteorological Acquisition System

Shipboard Meteorological System
MetAcq Operator's Manual

Shipboard Technical Support

Revision 1.80
03 November 2003

1. General Information

This system acquires, filters, averages, corrects, displays and distributes meteorological sensor data from a wide variety of sensor types and serial data streams.

Meteorological sensors such as ones made by RM Young, Vaisala, Alden, Coastal Environmental Systems, Seabird, FSI, Omega and most sensors that have an RS485, RS422, RS232 digital interface or any analog sensor that can output a voltage, frequency or 4-20ma current can be accommodated.

Atmospheric meteorological sensors are generally located on either the forward part of the ship on the MET mast and/or above the ship's upper bridge deck. Sensors that measure seawater properties are generally located near the uncontaminated seawater intake area or in one of the ship's laboratories that has a connection to the uncontaminated seawater line.

A typical system measures air temperature, barometric pressure, wind speed/direction, relative humidity, short wave radiation, long wave radiation, seawater temperature and seawater conductivity. Sensor information is combined with time, Gyro and GPS position information and displayed/stored on the acquisition device.

The main acquisition device is a Windows based computer that is has at least two serial ports. Data can be acquired simultaneously on all enabled ports. One or more ports can be configured to support RS485 communications through RS232 to RS485 converters. Sensors that have analog outputs are first connected to signal conditioning modules that are physically located near the sensor. These modules then convert the analog signal to RS485 that is then routed to the lab. Collected data is stored on data files at user-selected intervals. This interval is typically once every 30 seconds. Acquired data that has been collected from the sensors (uncalibrated) is stored in an uncorrected data file. Data that has been corrected by applying the most recent precruise calibration data is stored in a corrected data file.

At least once a year all Sensors are removed from the vessel, refurbished and calibrated at an appropriate shore based maintenance/calibration facility. Calibration data for each sensor is kept onboard each vessel and entered into the shipboard acquisition/setup file that is used by the acquisition program to correct sensor data for display and storage.

1.1.0 Meteorological Acquisition Program

The acquisition program was written in the Labview programming language. It acquires, displays and stores meteorological data in real-time.

Main features:

1. Acquire data from any number of sensors or instrumentation
2. Data Displays present data in numerical form (either calibrated or uncalibrated)
3. Real-time 18-strip chart displays that chart user selected data vs. time.
4. History scroll bar on each strip chart that allows viewing of previously displayed data
5. Ability to output hardcopy of the displayed data.
6. Write data to files at user selected intervals (calibrated and uncalibrated)
7. Variable user defined data output formats that can be output to serial port or file.
8. Ability to playback and view any standard data file.

1.2.0 Minimum Systems Requirements

Microsoft Windows 2000
Pentium II 800MHZ or higher processor
XGA Video card and monitor capable of 1024x768 16 bit color 64MB RAM
2-34 RS232 Comm ports
Installed on hard drive (20GB or higher)
National Instruments Labview Runtime engine v6.1
National Instruments VISA Runtime engine v2.6
STS MetAcq.exe Acquisition program

1.3.0 Contact Information

For help or assistance with any part of the meteorological system contact:

Shipboard Technical Support 0214
Shipboard Electronics Group
tel (858)534-1907
fax (858)534-7383
email: all-at-seg@odf.ucsd.edu

Meteorological Acquisition Program written by:
Carl Mattson
Shipboard Technical Support 0214
cmattson@ucsd.edu
tel (858)534-1907

2. Meteorological Sensor types

A sensor type is a software module that produces one complete data set for a particular function. For example, WND is a module of the wind sensor type; it consists of two sensors that output one data set that contains two raw values – 1.Wind Speed, 2.Wind Direction. From these two raw values, calculations may be applied to output corrected values as well as calculated values. For example the wind sensor type can be set to output True Wind Speed and True Wind Direction as well as the relative values. Each sensor type has an ID that is similar to the address values of the older Alden IMET system modules. However, in this case the sensor ID's are no longer address values with the exception of an installation that still uses the Alden Imet modules.

The first three letters of the sensor modname must begin with one of the following Type designators. The next two characters should be an ID to determine which module is selected. Each sensor used on SIO ships is assigned it's own ID. In this system there are 30 predefined module types that cover the most requested sensor types.

Item	TYPE	Description	Associated Parameters (Appendix A)
1	TMP	Air Temperature	AT
2	HRH	Relative Humidity, Temperature	RH, RT, DP
3	BPR	Barometric Pressure, [Compensation Temp]	BP, BC
4	PRC	Precipitation	PR, PT
5	WND	Wind Speed, Wind Direction	WS, WD, WK, TK, TW, TI
6	SWR	Short Wave Radiation	SW
7	LWR	Long Wave Radiation Dome Temperature, Body Temperature, Thermopile voltage	LW, LD, LB, LT
8	FLW	Flowmeter	FM, FI
9	SST	Surface Seawater Temperature	ST
10	SSC	Surface Seawater Conductivity	SC
11	VLT	A/D Volts	VT
12	FLU	Fluorometer	FL, TB
13	XMS	Transmissometer	TR, BA
14	OXY	Oxygen	OC, OT, OS, OX, OG
15	TSG	Thermosalinograph	TT, TC, SA, SD, SV
16	USP	Unspecified (user defined)	XX
17	PAR	Surface PAR	PA
18	AWT	Auxiliary Water Temperature	WT
19	AXT	Auxiliary air Temperature	AX
20	IST	Instrumentation	IP, IT, IS, IA, IV, IX
21	PRS	Pressure	PS
22	PDR	Water Depth	BT
23	NME	NMEA messages	LA, LO, CR, SP, GT
24	GYR	Gyro	GY
25	ASH	Ashtech Heading, Pitch, Roll	SH, SM, SR
26	TSV	Time Server	TS
27	WCH	Winch Wire Out, Wire Speed, Tension	ZO, ZS, ZT
28	ALK	Alkalinity (pH)	PH
29	VRU	Vertical Reference Unit (Pitch, Roll, Heave)	VP, VR, VH, VY, VX
30	SOW	Ship's Speed Log (Speed over water)	SL

Sensor Type Default Settings

Sensor Type	Num Raw Values	Num Cor Values	Precision	Parameter Tag	Range MIN	Range MAX
TMP	1	1	2	AT	4.00E+1	5.00E+1
HRH	2	3	2 2 2	RH RT DP	0.00E+0 -4.00E+1 -4.00E+1	1.00E2 5.00E1 5.00E1
BPR	1	1	2	BP	8.00E+2	1.10E+3
PRC	1	1	1	PR	0.00E+0	5.00E+1
WND	2	4	1 1 1 1	WS WD TW TI	0.00E+0 0.00E+0 0.00E+0 0.00E+0	2.00E+2 3.60E+2 2.00E+2 3.60E+2
SWR	1	1	1	SW	-5.00E+3	5.00E+3
LWR	3	4	2 2 1 1	LD LB LT LW	2.00E+2 2.00E+ 2 -5.00E+3 -2.00E+3	5.00E+2 5.00E+2 5.00E+3 2.00E+3
FLW	1	1	1	FI	0.00E+0	1.00E+3
SST	1	1	3	ST	-5.00E+0	5.00E+1
SSC	1	1	3	SC	-5.00E+0	9.00E+1
VLT	1	1	3	VT	-1.00E+2	1.00E+2
FLU	1	1	3	FL	-5.00E+2	1.00E+5
XMS	1	2	3 3	TR BA	0.00E+0 -1.00E+2	1.00E+2 1.00E+2
OXY	2	4	3 3 3 4	OC OT OX OS	-5.00E+0 -5.00E+0 -1.00E+1 -1.00E+1	1.00E+4 5.00E+1 1.00E+4 1.00E+4
TSG	2	5	3 3 3 3 3	TT TC SA SD SV	-5.00E+0 -5.00E+0 0.00E+0 0.00E+0 1.40E+3	5.00E+1 1.00E+2 8.00E+1 5.00E+1 1.60E+3
USP	1	1	3	XX	-1.00E+6	1.00E+6
PAR	1	1	2	PA	-1.00E+5	1.00E+5
AWT	1	1	2	WT	-5.00E+0	5.00E+1
AXT	1	1	2	AX	-4.00E+1	5.00E+1
PRS	1	1	2	PS	-5.00E+1	1.00E+5
PDR	1	1	1	BT	-5.00E+0	1.50E+4
NME	5	5	6 6 1 1 1	LA LO GT CR SP	-9.00E+1 -1.80E+2 0.00E+0 0.00E+0 0.00E+0	9.00E+1 1.80E+2 8.64E+4 3.60E+2 5.00E+1
GYR	1	1	1	GY	0.00E+0	3.60E+2
ASH	3	3	1 1 1	SH SM SR	0.00E+0 -3.00E+1 -6.00E+1	3.60E+2 3.00E+1 6.00E+1
TSV	1	1	0	TS	0.00E+0	8.64E+4
WCH	3	3	1 1 1	ZO ZS ZT	-2.00E+4 -2.00E+4 -5.00E+4	2.00E+4 2.00E+4 5.00E+4
ALK	1	1	2	PH	-1.50E+1	1.50E+1

VRU	3	5	1 1 2 1 1	VP VR VH VY VX	-6.00E+1 -6.00E+1 -1.50E+1 -6.00E+1 -6.00E+1	6.00E+1 6.00E+1 1.50E+1 6.00E+1 6.00E+1
SOW	1	1	1	SL	0.00E+0	8.00E+1

If not so specified the above values are what the program uses for default values. Default settings for any sensor type can be changed and/or can be overridden in the ACQ file using the Keys: TAGS-C, TAGS-R, PRC-C, PRC-R, RANGE (see Section 9).

3. Installation

Certain applications must be installed on the computer before the system can operate.
1. National Instruments Labview Runtime engine v6.1
2. National Instruments VISA Runtime engine v2.6
3. STS MetAcq.exe Acquisition program and supporting files

Refer to documentation supplied by National Instruments for instructions on installing the NI Labview Runtime engine and NI VISA Runtime engine. The Labview Runtime engine should be installed prior to the VISA Runtime engine.

The Windows path name is set to include C:\Wbin in the main path.
The following files are installed in C:\Wbin:
MetAcq.exe MetAcq.ini Metacq.dsp settime.dll

Web Server support files are installed in C:\Wbin\www.

Met system manuals and documentation are located in C:\MET.

3.1.0 Program setup and corrections file

This file contains serial port, program parameters and sensor setup and calibration data that the program uses for the following operations:

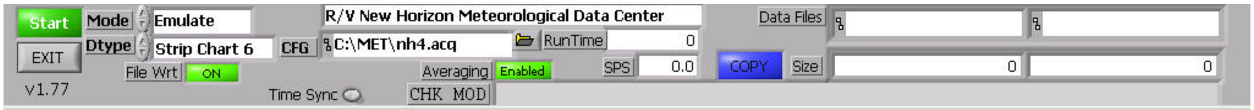
1. Activation and setup of computer serial ports
2. Activation and selection of sensor input modules
3. Setup of sensor address and communication parameters
4. Setup of desired correction/calibration algorithm
5. Sensor calibration coefficients
6. Data averaging parameters
7. Specify user defined output modules for serial port/data file writes

Program setup and corrections file <name>.ACQ is located in a user-designated directory (default directory is C:\MET). All MET data is written to the same directory that the selected ACQ file is located.

See Section 7 and Section 9 for details on the setup and corrections file.

4. Operation

After the Met acquisition computer is properly configured and setup then the following procedures can be used to perform program operations.



4.1.0 Startup Procedure (quick)

1. Power ON the MET computer
2. Ensure power is ON to all Met sensors
3. Observe that the Windows operating system is properly booting up.
4. The acquisition program will start. The program control panel will appear on the monitor.
5. At this point you can do one of two things.
    1. Do nothing; the program will start in about 30 seconds.
    2. Click on the green control button labeled <Start>

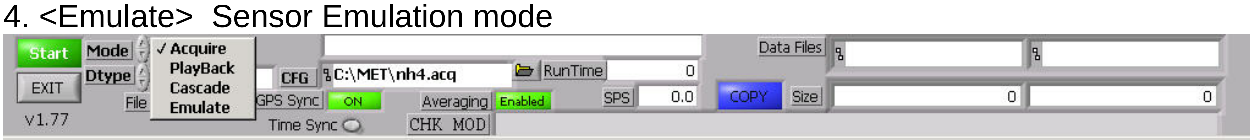
Note that the acquisition program is set to start automatically upon boot up.

4.2.0 Startup Procedure (detailed)

1. Ensure power is ON to all Met sensors
2. Ensure acquisition computer is powered up and booted up to the Windows operating system
3. On the Windows desktop display, using mouse, select the icon labeled MetAcq.exe
4. After the acquisition program is loaded, the user will see a control panel. At this point the program is in Standby. During Standby mode you may select the desired met configuration file, mode of operation, type of display, enable/disable of automatic time sync and enable/disable data averaging. The lower control panel also contains several status indicators that can be observed during program operation.
5. After making the desired selections, click on the green control button labeled <Start>

4.2.1 Modes of Operation

1. <Acquire> This is the normal mode for data acquisition
2. <Playback> Playback any archived data file
3. <Cascade> Display data sent by RS232 from the primary acquisition PC
4. <Emulate> Sensor Emulation mode



4.2.2 Configuration File Select

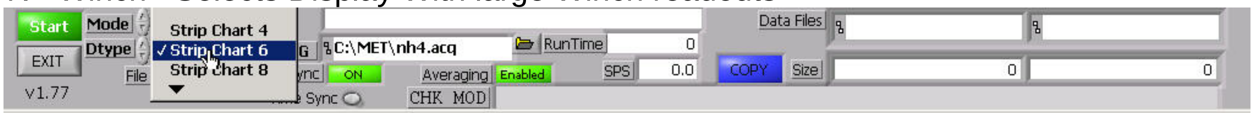
The configuration file used by the acquisition program may be selected by using the indicated control. Just click on the little yellow folder symbol on the right side of the control. The configuration files are indicated be the file extension ACQ (For example SPROUL.ACQ).

4.2.3 Time Synchronization

If a Network timeserver is connected to the network then the system time of the MET acquisition computer is automatically synchronized to the timeserver time using NTP protocol. When no network time server is connected then the MET acquisition computer the system computer time will be synchronized to the time obtained from the GPS. When GPS Sync is enabled, and it is desired to synchronize the time manually, then click on the Time Sync control located just below the GPS Sync control.

4.2.4 Display Modes

1. <Strip Chart4> Selects 4 strip charts with 30 numeric parameter display indicators.
2. <Strip Chart6> Selects 6 strip charts with 30 numeric parameter display indicators.
3. <Strip Chart8> Selects 8 strip charts (Numeric displays are not shown in this mode).
4. <Tabulated>   Selects Tabulated display with 30 parameter display indicators.
5. <Tabulated-GPS> Selects Tabulated display with GPS indicators and 30 displays.
6. <Fixed> Selects Fixed display showing the basic suite of MET data.
7. <Winch> Selects Display With large Winch readouts



The Display mode has no effect on what data is stored in the MET data files. The information in the data files is determined by which sensors are activated in the configuration file.

4.2.5 Enable Data Averaging

When ON data averaging is enabled. The averaging setup parameters must be specified in the module section of the setup file (see section 9.3.0). Averaging can be enabled or disabled individually for any sensor. Averaging time can also be specified for any sensor. There are two types of averaging available. 1-Normal, 2-Vector. Vector averaging is used only on sensors that output in angular degrees such as wind direction.

4.2.6 Status Indicators

Runtime indicator – displays the length of time the program has been executing without interruption.

Scans Per Second (SPS) indicator – displays the number of times per second that the program scans through all of the sensors. This gives a general idea of how well the program is working. With several sensors the SPS will be lower; with few sensors the SPS will be higher. Generally the SPS should always be above 0.5 to indicate proper program execution.

Data Files indicator – displays the name and path of the data file that is currently being written. There are at least two files that the program updates every write interval. One file for the corrected data and the second for the uncorrected data. A new set of data files are started at the beginning of each (GMT) day beginning at 0000Z. Section 10 describes the data files.

SIZE indicator – displays the size in bytes of the data files. After each data write interval this value will   increase.

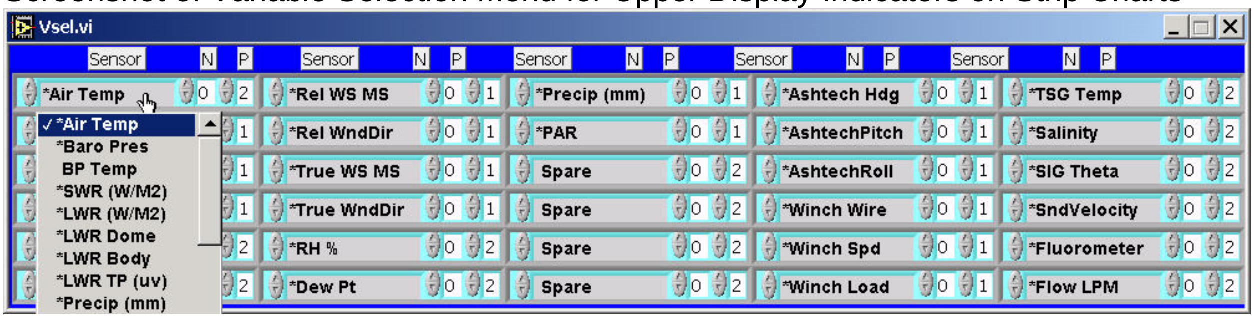
CHK MOD indicator **–** Displays a list of sensors that fail to respond or output data. If a failure has been indicated there are 3 possibilities.

1. The sensor(s) have failed
2. The sensor power is OFF
3. The sensor(s) have been disconnected.

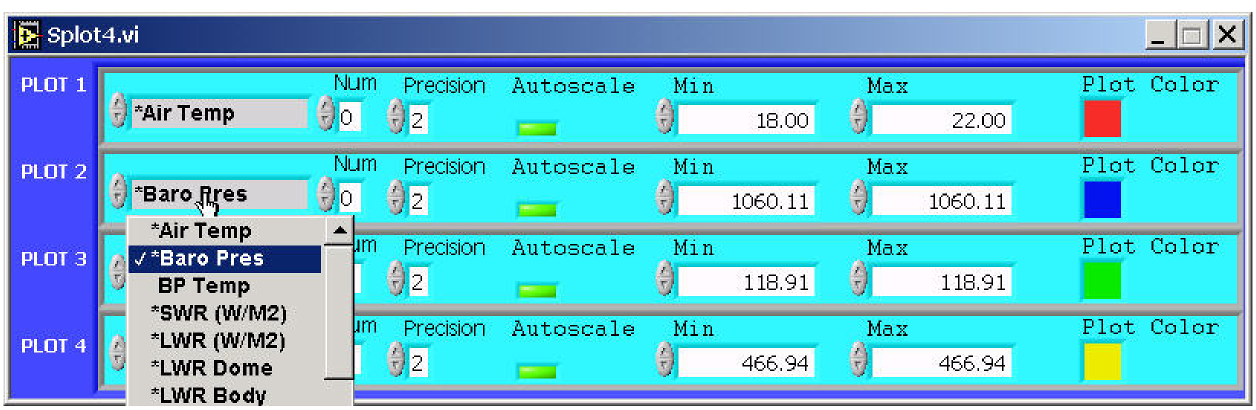
4.3.0 Program Operation

After the program has been started as described in sections 4.1.0 or 4.2.0, the main display Window appears. This Window will be one of eight different configurations depending on the Display Modes setting. The Display Mode setting may be changed to another type of display at any time. In each display mode every window has it's own menu to select desired values to display and plot. To change the displays – click the control button to access the pop up menu on the upper left – labeled <Displays>. In the popup display you can change the parameters, sensor module, and number of decimal places that are displayed. When finished making selections click on the <X> on the upper right corner of the display.

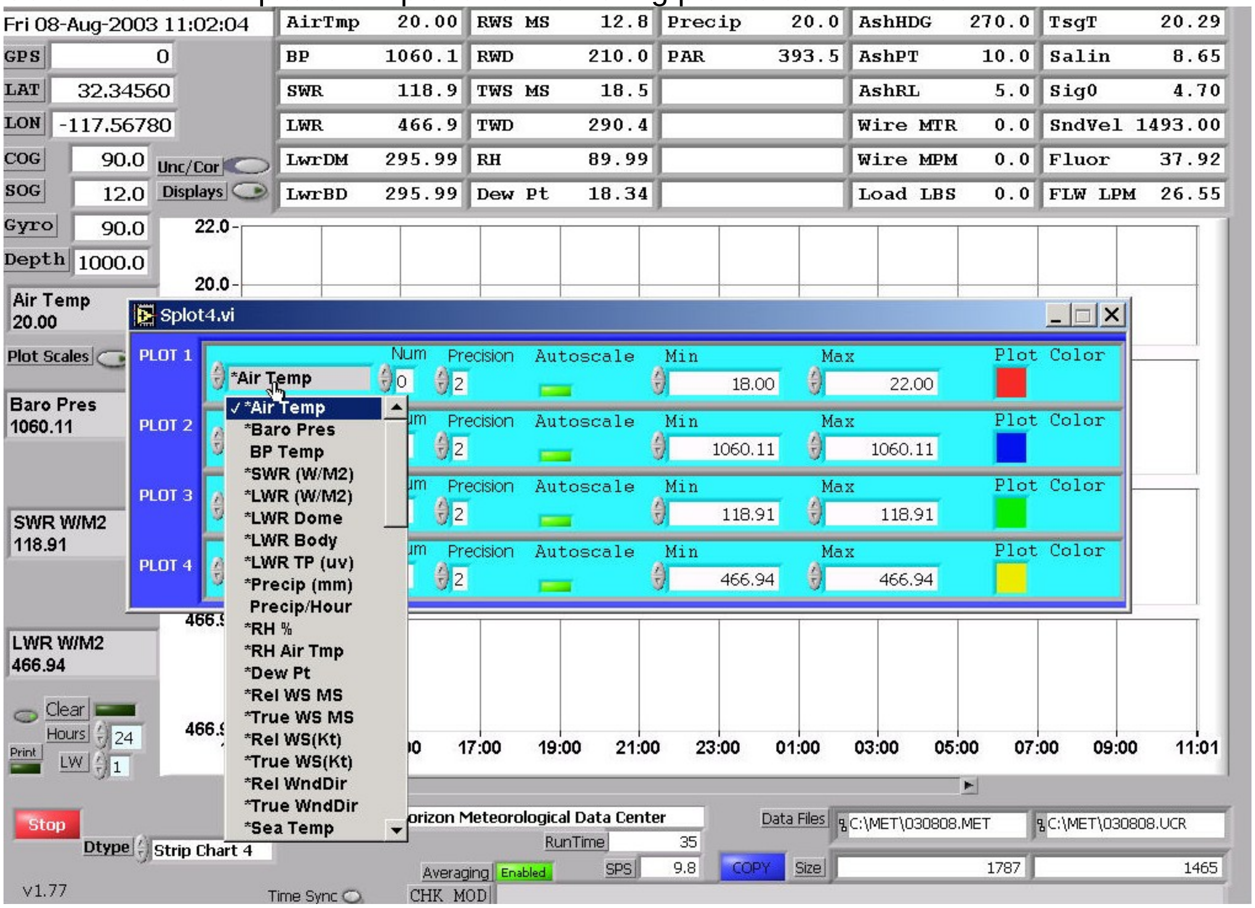
Screenshot of Variable Selection Menu for Upper Display Indicators on Strip Charts



Additionally you can change the parameter to be charted on any of the strip charts by clicking on the <Plot Scales> control. In this popup display you can select the parameters, sensor module, number of decimal places, auto scale enable, minimum scale value and maximum scale value. The sensor module selection on either the display selection or plot section allows you to select between redundant sensors. For example, if there were two air temperature modules and you wished to chart the second one, select it's module number. Module numbers are numbered starting from zero. Zero being the first module. The minimum and maximum scale values can only be accepted if the autoscale is turned OFF. When autoscale is ON the program automatically adjusts the minimum and maximum scale values. The AUTOSCALE is initially enabled but if it is desired to manually set the scales of the Plot. Click on autoscale to disable it. Then either enter the Min/Max values in the Plot Scales popup or simply click on the upper and lower scale values on the chart, then enter the desired values.



Screenshot of Strip Chart 4-plot after activating plot selection menu

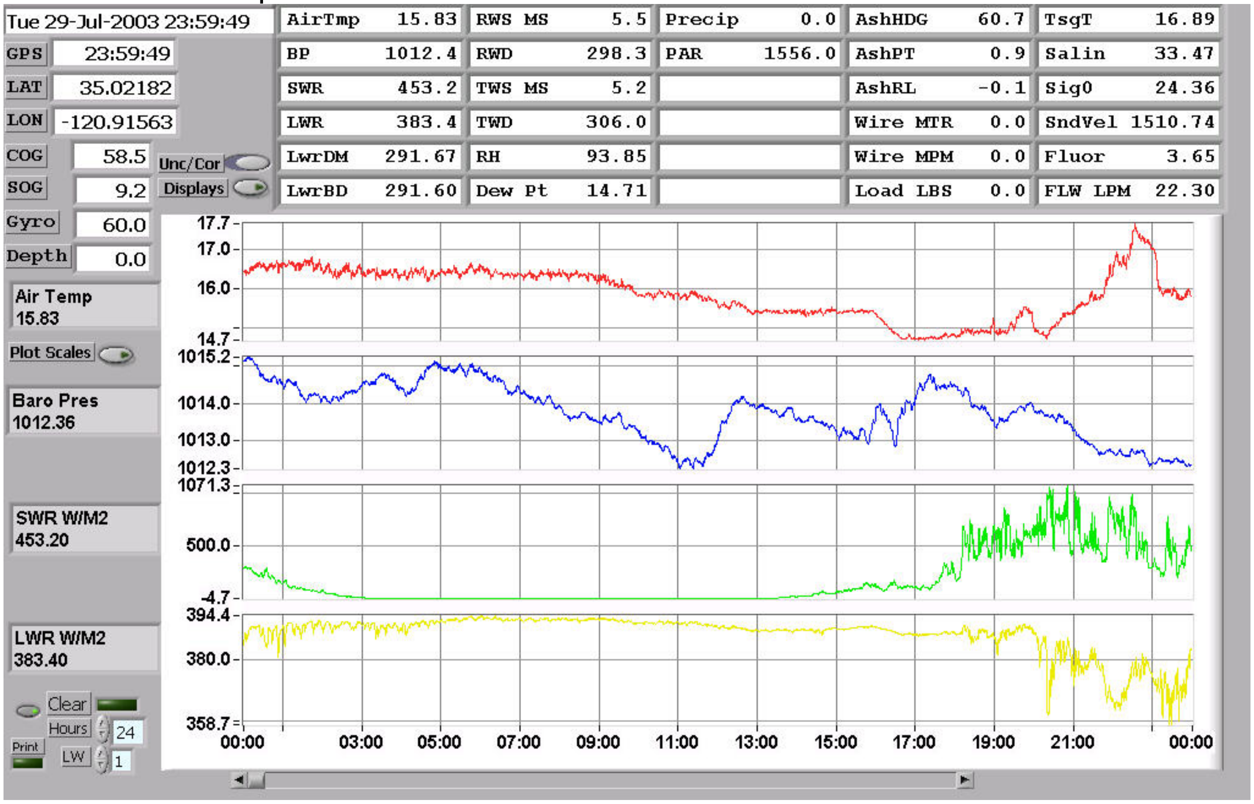


The strip charts have a history bar. If it is desired to view data that has already scrolled off the screen move the history bar to the desired setting.
The Clear Plot control clears the plot and plot history.

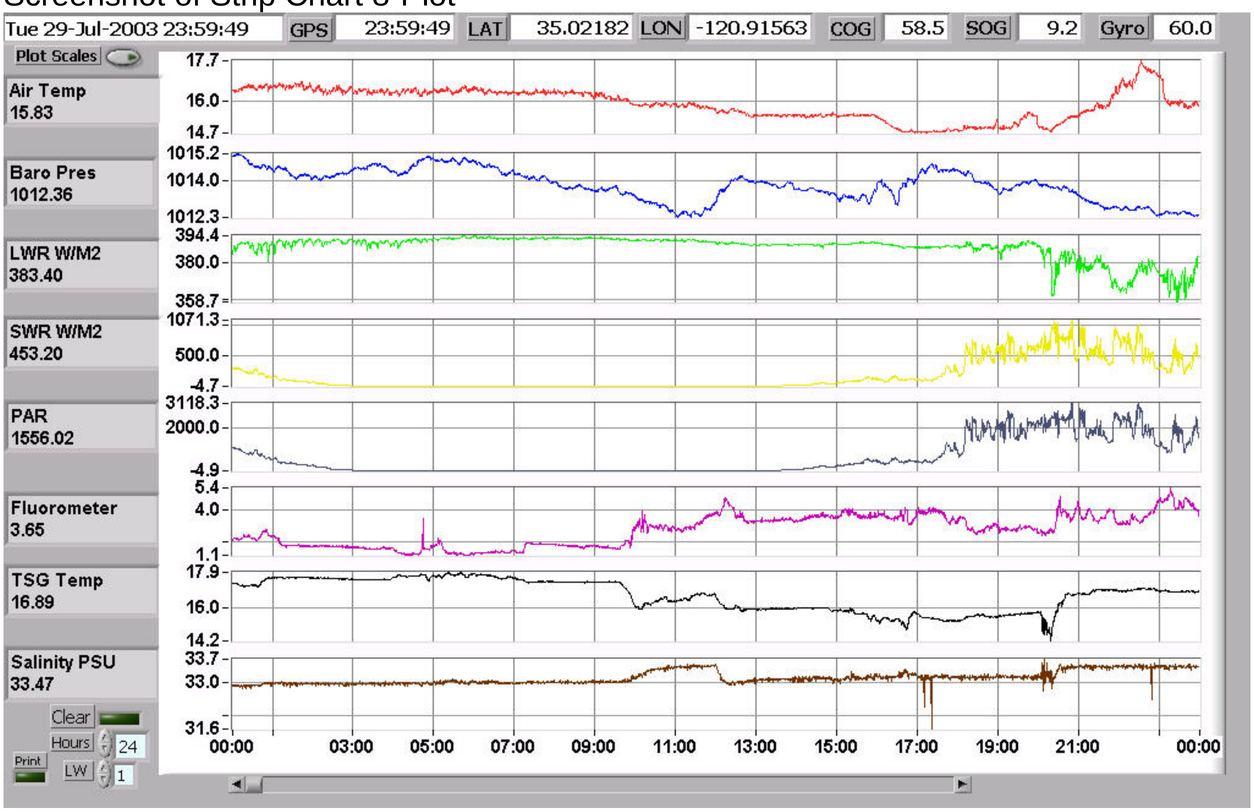
The Time Scale may be changed to any value in hours. Initially it is set to 24 hours. To change, move the mouse on the control and click to enter the value. Each time the Time Scale is changed you must also click on the clear plot control to view the new chart time scale.

The PRINT control allows the plot that is currently displayed to be sent to a printer. Before using this control the printer must be properly connected, have a windows driver installed, must have paper and be turned ON. The printer control may be disabled in the program setup file using the keyword PRINT_EN = FALSE. (Section 9)

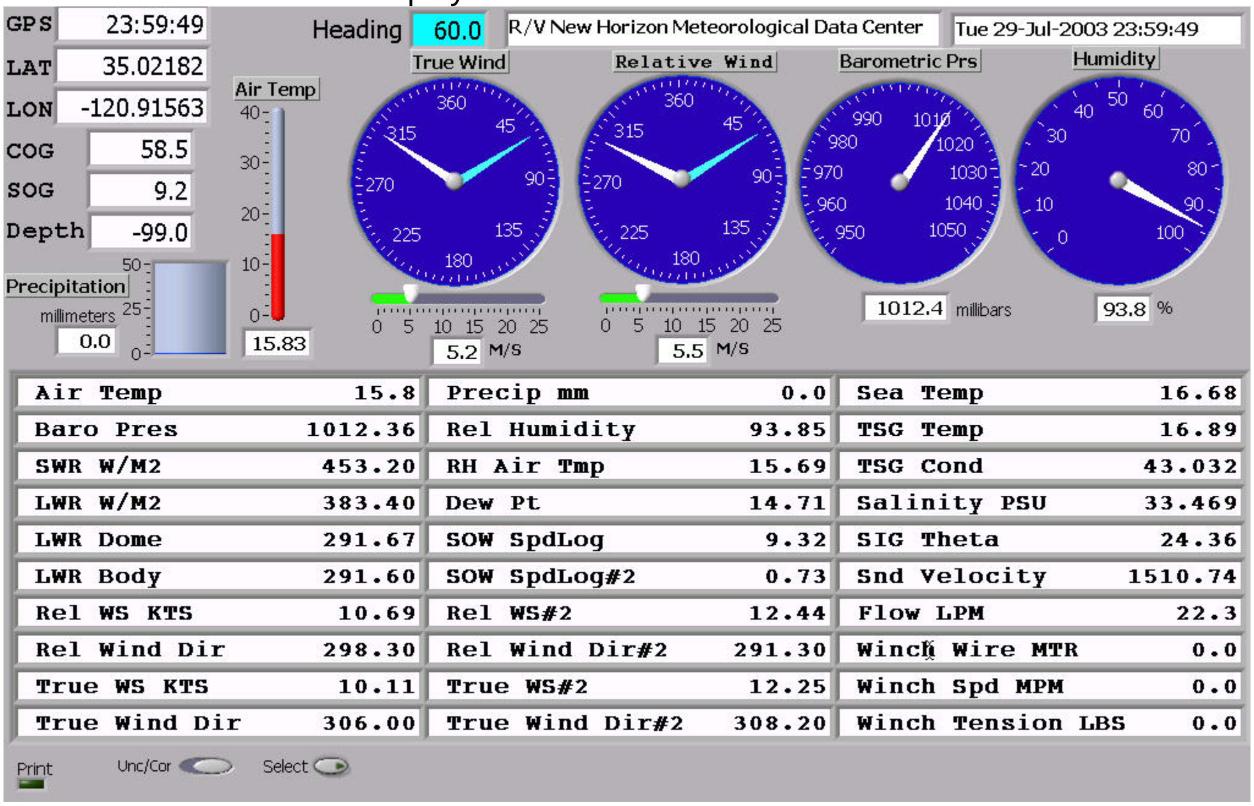
Screenshot of Strip Chart 4-Plot



Screenshot of Strip Chart 8-Plot



Screenshot of Tabulated Display



Screenshot of Variable Selection Menu for Tabulated Display

4.3.1 GPS Display - Setting Waypoints

On the Display mode selector control, set the display to Tabulated-GPS. Waypoints may be viewed and selected on the right side of the display. Once selected the following data will be calculated and continuously updated in the appropriate displays.

1. ETA – Estimated Time of Arrival to selected waypoint.
2. EDA – Estimated Date of Arrival.
3. TTG – Time to go before arriving at waypoint.
4. Distance in Nautical Miles to the selected waypoint
5. Bearing from the present location to the selected waypoint

In order to utilize this function you first need to setup a waypoints file and place this file in the same directory that the ACQ file is in and where the data files are written. Upon startup the program first looks for a file called <Waypoints>, if this file is not present then it will look for a file called <MetAcq.wpt>. The format of the waypoints file only allows one type of format as follows. Station, LAT, LON (deg min)   001, 32 30.0N 117 30.0W

```
Test  42 46.32 N  58 54.52 W 3100
001   43 14.80 N  50 37.00 W   81
002   43 10.00 N  50 41.00 W   85
003   43  6.00 N  50 45.00 W   95
```

The Format of the MetAcq.wpt file can be one of three types of formats as follows:

```
# MetAcq Waypoints List
# delimit by commas or tab
# FORMAT=0  Station, LAT, LON (decimal)           001, 32.500, -117.500
# FORMAT=1  Station, LAT, LON (signed deg min) 001, 32 30.0 -117 30.0
# FORMAT=2  Station, LAT, LON (deg min)          001, 32 30.0N 117 30.0W
# Waypoint name or number, Latitude, Longitude
#
FORMAT=2
Test  42 46.32 N  58 54.52 W 3100
001   43 14.80 N  50 37.00 W   81
002   43 10.00 N  50 41.00 W   85
003   43  6.00 N  50 45.00 W   95
```

In both types of files, the waypoint can be a number or a name. Do not use spaces within the name of a waypoint. E.g. a waypoint called San Diego should be designated as San_Diego. Lines beginning with '#' are comments and ignored. Any number of waypoints may be entered in the file.

The Waypoints file can be read into the program at any time. It is not necessary to stop and start the program. Just place the new waypoints file in the data directory, then click on the control labled <Read New Waypoints>. The new waypoints will then be available for selection.

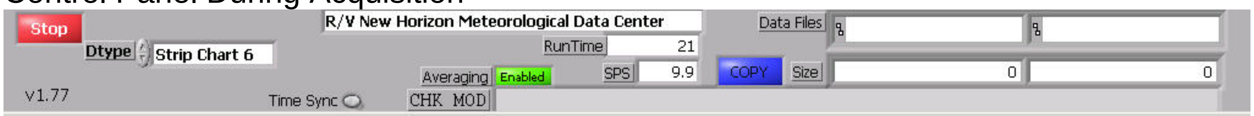
If the Bearing to waypoint is greater than +/- 45 degrees of the ship's heading the indicated ETA will say <CHK WPT>. Once the ship's heading (COG) agrees (more or less) with the Bearing then you will see a calculated ETA.

4.4.0 Program Termination procedure

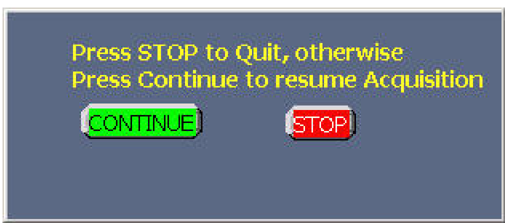
To terminate the acquisition program move the mouse to the red control labeled <Stop> located in the lower left side of the screen. Click the mouse on this control. A Popup window will appear to verify that you wish to cease acquisition. If you confirm that you want to stop the acquisition then click on the red <STOP> control located in the popup window. The acquisition program will stop acquisition and data file logging and then enter standby mode.

To End the acquisition Click on the red <Stop> button

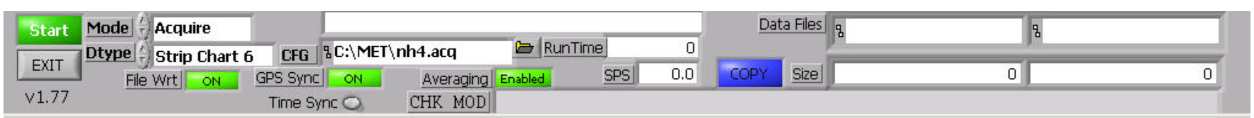
Control Panel During Acquisition



After the Verify popup appears, Click on the red <Stop> button to stop the program.



The Program is now in standby.
The program can then be reactivated at any time by hitting the green <Start> control.



If it is desired to quit the acquisition program completely, click on the control labeled <EXIT>.

The <EXIT> control can only be reached during standby mode.

5. Connecting to the WEB Server

The meteorological displays can be viewed on any computer that is connected to the network. A web browser such as Microsoft Internet explorer or Netscape that is running on any computer such as Solaris, Linux, Unix or Apple operating system can access the MET Display.

The Web server function is independent of any computer or system on the network. It will work in either a network that has a Unix or Windows name server station or in a network that consists of only the MET acquisition computer and the user's local computer.

5.1.0 Setting up the Web Browser

On the MET acquisition PC the file METACQ.INI is usually located in C:\Wbin directory. Ensure that it contains the following statement:
[MetAcq]
WebServer.Enabled=True

Any panel can be viewed on any browser regardless of the Display Mode setting of the acquisition computer. Any Strip chart can be viewed on the browser at the same time that Tabulated displays or another strip chart type is shown on the acquisition PC. The following panels are available.

Display Mode	Panel	Display Mode	Panel
Strip Chart 4	Metdisp.vi	Tabulated-GPS	MetGPS.vi
Strip Chart 6	Metdisp6.vi	Fixed	MetFixed.vi
Strip Chart 8	Metdisp8.vi	Winch	MetWinch.vi
Tabulated	Metnum.vi		

The user's computer needs to be connected to the same network that the MET acquisition PC is connected. It must be configure to the network in the standard method used on a particular vessel or laboratory. The IP number is assigned or DHCP is used.

On the user's computer, start the web browser. If using Netscape or Internet Explorer press the <F11> key (on the user's computer). This will put the browser in full screen mode for best viewing. (To switch back just press <F11> again).

There are three methods that can be used to view the met display on a web browser.

1. In the location on the browser that you ordinarily specify the web address enter the network name or IP number of the MET PC. The MET home web page will now be visible. From this web page select the link to the desired display or follow the navigation arrow in lower right of the screen. This arrow can be followed on each panel is succession.
2. Using method#2 you can go directly to the desired screen without using the above menu. Enter the network name or IP number of the MET PC followed by one of the following:

/metdisp4.htm /metdisp6.htm /metdisp8/htm /metnum.htm /metgps.htm metfixed.htm
E.g. http://metpc/metdisp.htm

3. The third method is as follows:

   Assuming the MET computer's ID is called metpc and you choose to view the Strip Chart 4 display

http://metpc/.snap?metdisp.vi

If DNS is not enabled or there is no host file then use the IP number of the MET acquisition computer e.g.

http://100.100.100.001/.snap?metdisp.vi

For Continuous updates use the following:
http://metpc/.monitor?metdisp.vi&refresh=15&lifespan=0

Refresh specifies the number of seconds between updates.Lifespan is the number of seconds that the WEB page remains active. Lifespan=0 specifies no time out.
Using Method #1 the following screen will appear on the local computer. Select the link to the desired display or click on the arrow on the right side of the page. On the lower right of each page is an arrow to allow going to the next screen in sequence. On the local computer start the browser then enter the address. Press the function key <F11> to get full view.

SCRIPPS
INSTITUTION OF
OCEANOGRAPHY

Meteorological Acquisition System

Stripchart Display 4-Plot
Stripchart Display 6-Plot
Stripchart Display 8-Plot
Tabulated Display
Tabulated-GPS Display
Fixed Display
MET Program Manual
      MetAcq Program Documentation
Met Sensor Specs
      Meteorological Sensor Documentation
MET Data Directory

5.1.1 Downloading images

To download any display image such as a strip chart, place cursor on display and right click on the mouse. Select “Save picture as…” then enter filename info to save the file.

5.1.2 Network tips

When connecting to the MET acquisition computer in a network that has no DNS or DHCP server, it may be necessary to change the IP number of the local computer. The first nine numbers should be made the same as the first nine numbers of the MET computer. However, the last three numbers must be a unique number.

6. Copying Data Files

There are several ways to copy data files.
It is not necessary to interrupt the acquisition program.
Files may be copied at any time.

1. Open a Command Prompt Window, then use the COPY command to copy files to the backup
   device. For example;
   COPY *.MET E:
   This will copy only files of type .MET to drive E:

2. Open Windows Explorer, select the data directory, select the desired files to copy, and then select “COPY to folder” then enter the destination directory.

3. Click on the COPY control button located on the acquisition program control panel. Click OK when ready to copy. This will copy all files in the MET data directory onto the computer's ZIP disk. Be sure to insert a formatted, blank zip disk with sufficient free space to hold the files prior to clicking on the control.

4. If the FTP server is enabled and the network is operational, data files may be directly downloaded from the MET PC directly to the local computer. Enter the following command.
ftp <network name of METPC>.ucsd.edu
or
ftp <ip number of MET PC>

5. Files may also be downloaded via the MET PC web server (see section 5).

7. Configuring Data Input Ports

7.1.0 Functional Description

The first part of the acquisition setup file determines how Input ports are assigned as well as the characteristics of each port. Up to 34 ports may be accommodated. In the section that follows, each line begins with a UNIT device number. This number is not the computer's COMM port number but is the Logical Device number that the labview program uses to identify a particular port. There are three basic types of input ports: RS232, RS485 and UDP.

7.1.1 RS232

RS232 devices transmits their signal in a dedicated unbalanced transmission line. The transmitted signal is referenced to signal ground.

7.1.2 RS222

RS422 devices transmits their signal in a dedicated balanced transmission line. In a balanced differential system the voltage produced by the driver appears across a pair of signal lines sometimes referred to as A and B output terminals.

7.1.3 RS485

The EIA RS-485 Standard permits a balanced transmission line to be shared in a party or multidrop mode. As many as 32 driver/receiver pairs can share a multidrop network. Many characteristics of the drivers and receivers are the same as RS422. Each RS485 device is accessed to talk by sending it the correct address and command line string. The instrument then responds to the particular command then it relinquishes the transmission line.

7.1.4 UDP (User Datagram Protocol)

UDP provides simple, low-level communication among processes on computers. Processes communicate by sending datagrams to a destination computer or port. A port is the location where you send data. IP (Internet Protocol) handles the computer-to-computer delivery. IP performs the low-level service of moving data between computers. IP packages data into components called datagrams. A datagram contains, among other things, the data and a header that indicates the source and destination addresses. IP determines the correct path for the datagram to take across the network or Internet and sends the data to the specified destination. Once the datagram reaches the destination computer, UDP moves the datagram to its destination port. If the destination port is not open, UDP discards the datagram.

UDP datagrams that are currently recognized are:
GGA, VTG, GLL, RMC, HDT, SHR (Ashtech), ZDA, MWV, DBT, VHW, VBW, PKE (Knudsen), BPR, IMET_HRH, IMET_WND, IMET_PRC, IMET_SWR, EDO, SSTMP, SSCND, Salinity, Fluorometer and Air_Temp. Many of these datagrams are described in Appendix B and C.

7.1.5 Analog Input devices

MET sensors that output analog signals such as volts, 4-20ma current and frequency are usually connected to an analog to RS485 converter located near the sensor. The converter can be a multichannel or single channel device.

7.2.0 Input Port Data Types

Data Type	Column 2 Function Code	Column 3	Column 4	Column 5	Column 6	Column 7
RS232, RS422, RS485	Code 1	COM Port	Baud Rate	Parity NONE, EVEN, ODD	Data Bits 7 or 8	Stop Bits 1 or 2
UDP	Code 80	Ignored	UDP Port	Ignored		Ignored

Everything after Column 7 is ignored by the program. This area can be used for descriptive comments.

```
#  Port and Sensor Configuration/Calibrations file
#
UNIT1   0 COMM1  9600 NONE 8 1   Spare
UNIT2   0 COMM2  9600 NONE 8 1   Spare
UNIT3   1 COMM3  9600 NONE 8 1   RS485  - MET Mast Sensors
UNIT4   1 COMM4  9600 NONE 8 1   RS485  - Flo-thru sensors
UNIT5   1 COMM5  9600 NONE 8 1   RS485  - FSI CT sensors
UNIT6   1 COMM6  4800 NONE 8 1   RS232 Input  - GPS Pcode
UNIT7   1 COMM7  9600 NONE 8 1   RS232 Input  - Gyro
UNIT8   1 COMM8  9600 NONE 8 1   RS232 Input  - Knudsen Depth
UNIT9   1 COMM9  9600 NONE 8 1   RS232 Input  - Ashtech
UNIT10  1 COMM10 9600 NONE 8 1   RS232 Input  - Time Server
UNIT11  7 COMM11 9600 NONE 8 1   RS232 Output - SB2000 Nav
UNIT12 10 COMM12 9600 NONE 8 1   RS232 Output - VTG, HDT to MRU
UNIT13 17 COMM13 9600 NONE 8 1   RS232 Output - TSG Data to Gyro box
UNIT14  4 COMM14 9600 NONE 8 1   RS232 Output - MET Data to Main Lab
UNIT15  0 COMM15 9600 NONE 8 1   RS232 Output - Surf PAR to SBE11
UNIT16  0 COMM16 9600 NONE 8 1   Spare
UNIT17  0 COMM17 9600 NONE 8 1   Spare
UNIT18  0 COMM18 9600 NONE 8 1   Spare
“”          “”
“”          “”
UNIT34  0 COMM34 9600 NONE 8 1   Spare
```

Any port may be assigned to any program UNIT number. But it is not permissible to assign a port more than once. If a UNIT device is disabled then the port number is ignored.

UNIT numbers that assign an active port to a particular sensor are placed in the Sensor Type setup file in the first number following the <MSP = > keyword. (See Section 9.2.0)

```
 MetAcq  Serial Ports configuration
1. a. Unit Device Number
   b. Unit Code
      0 Disable unit (If zero the sensor will be emulated)
      1 Enable unit
      2-20 Device Output code (see section 8)

   c. COMM port number
   d. Baud rate
      300 1200 2400 4800 9600 19200 38400 76800 115200
   e. NONE No Parity
      ODD  Odd Parity
      EVEN Even Parity
   f. Data bits 7 or 8
   g. Stop bits 1 or 2
```

Throughout the ACQ file, if the first character of a line starts with the '#' sign then it is treated as a comment line and ignored by the program. Blank lines are also ignored

8. Sending Serial Data

8.1.0 Functional Description

Serial data of various formats may be transmitted from the Acquisition computer to an external device or distribution network.

To assign output data to a serial port put the appropriate Output Code in the UNIT code location then set the desired baud rate, parity, data bits and stop bits. See section 9.3.0 The following pre-defined outputs are available. To specify user defined outputs see sections 8.13.0 and section 9.4.0
.

8.1.1 Serial Output Data Types

Data Type	Function Code	Output Interval	Comments
MET Data (Corrected)	Code 2	Any	(Format in Section 10)
MET Data (Uncorrected)	Code 3	Any	(Format in Section 10)
MET Data (Translator Format)	Code 4	Any	(Format in Section 10)
Seabeam 2100 Sound Velocity	Code 5	5 Secs	
Seabeam 2100 Navigation	Code 6	1 Sec	
Seabeam 2000 Navigation	Code 7	1 Sec	(Appendix C)
VTG, HDT Message	Code 10	1 Sec	(Appendix B)
EM120 Sound Velocity	Code 13	1 Sec	(Appendix C)
Surface Par Output	Code 14	1 Sec	
Calcofi(2003 MET Data Stream	Code 17	5 Sec	*
GLL, VTG, DBT, HDT	Code 18	1 Sec	(Appendix B)
User Defined	Code 20	Any	(Section 9.4.0)

*Calcofi 2003 MET Stream
$WICCI,ddmmyy,hhmmss, AT, BP, TK, TI, TT, SA, FL, LA, LO, T*<Checksum><cr><lf>
Precision 2 2 1 1 3 3 3 5 5 1

9. MET Input/Output Configuration

9.1.0 Module Activation Section

After the serial port section, the module selection section follows. Specifying the Sensor ID will activate sensors. Each Sensor ID that is specified must have its associated setup/calibration section attached in the latter part of the setup file.

An example module selection follows:

The word STARTMOD must be placed at the beginning of the sensor list. Each module has a 5 character ID that conforms to the specification from section 2. Each module included in the sensor list must have an entry in the module setup and calibration section.

```
STARTMOD
PRC01 TMP01 HRH01 BPR01 WND01 SWR01 LWR01 AXT11 VLT05 TSG01 FLW01 WND09 OXY02
AWT02 FLW02 FLU02 PAR01 NME01 GYR01
ENDMOD
```

The word ENDMOD must be placed at the end of the sensor list. When removing sensors you need only remove the name from the above list. You do not need to delete the sensor section itself.

9.2.0 General Section

The General section includes miscellaneous information such as Title, Copy file destination, Enable hardcopy print button (PRINT_EN) and Enable/Disable generation of data files in the Translator format (MK_COR and MK_UNC). TIMEOUT is the maximum number of milliseconds the program will wait for a response from a sensor. FileWriteInterval is the interval in seconds between file writes to a data file. SerialWriteInterval is the interval in seconds between serial output strings when the output Code is set to 2, 3 or 4.

General Section Keynames

[GENERAL]		Defaults
TITLE	Shipname	TITLE = R/V Sproul
ZIPDIR	Drive Letter	ZIPDIR = E:
PRINT_EN	Enable/Disable Printer TRUE or FALSE	PRINT_EN=FALSE
MK_MET	Enable/Disable MET FileTRUE or FALSE	MK_MET = TRUE
MK_UCR	Enable/Disable UCR FileTRUE or FALSE	MK_UCR = TRUE
MK_COR	Enable/Disable COR FileTRUE or FALSE	MK_COR = FALSE
MK_UNC	Enable/Disable UNC File TRUE or FALSE	MK_UNC = FALSE
MK_LOG	Enable/Disable LOG File TRUE or FALSE	MK_LOG = FALSE
CHART_RATE	Interval in Seconds that the Strip Chart Updates	CHART_RATE = 2.0
TIMEOUT	Timeout in milliseconds to wait for Sensor Response	TIMEOUT = 300
FileWriteInterval	Interval in Seconds between File Writes	FileWriteInterval=30.0
SerialWriteInterval	Interval in Seconds between Serial out messages	SerialWriteInterval=30.0

9.3.0 Input Module Setup and Calibration Section

Each Active module has a section that starts with the 5-character module ID enclosed in brackets. In these sections key names are used to assign sensor characteristics.

Input Module Section Key names

Keys		(Example)
SENSOR	Sensor Description	SENSOR = Air Temperature
MODEL	Model Number	MODEL = 41342LC
MFG	Manufacturer	MFG = RM Young
SERIAL	Serial Number	SERIAL = 3944
OWNER	Organization/owner of Sensor	OWNER = STS
CAL_DATE	Calibration Date	CAL_DATE = 03-Feb-03
CAL_LAB	Calibration Lab	CAL_LAB = ODF
LOCATION	Where Sensor is installed	LOCATION = FWD MET MAST
COMMENTS	Any Info	COMMENTS = Primary Air Sensor
CMD	Module address and/or command line sent to Sensor	CMD = #x\r (see backslash codes below)
MSP	Module Setup Parameters (see 9.3.1)	MSP = 3 1 0 0 10 0 1 1 0 0 0 0 0 0 0
MCP	Module Calibration Parameters (see 9.3.2)	MCP = 1 1 1 0 13 0 0 0 0 0 0 0
TAGS-C	Parameter Tags to include in corrected data file	TAGS-C = AT
TAGS-R	Parameter Tags to include in uncorrected data file	TAGS-R = AT
PRC-C	Precision (Num Decimals)corrected data	PRC-C = 2
PRC-R	Precision (Num Decimals)uncorrected data	PRC-R = 3
EMULATION	Emulation of Values before corrections	EMULATION = 70.0
AVGTYPE	Type of Average 0-None 1-Normal 2-Wind Vector	AVGTYPE = 1
SECSTOAVG	Number of seconds to average data	SECSTOAVG = 10.0
ADCALTYPE	A/D calibration type of each parameter	ADCALTYPE = 0
UCR_RANGE	Parameter Range limits – Uncorrected data	
ADCAL	A/D corrections	ADCAL = 1.0, 0.0
EVAL	Expression parser used in formula mode Section 9.3.3	EVAL = x*a+c
COR	Parameter corrections	COR = 9.96E-01, –49.92 1.0
RANGE	Parameter Range limits – Corrected data	RANGE = -40.0, 50.0
ADDTOFILE	Include in Data Files	ADDTOFILE = TRUE
DELIMITERS	Input data Delimiters Delimiters can be any ascii character(s) That are used to separate input values. Defaults are \t \n \r \s ,	DELIMITERS = \t \n \r \s , (see backslash codes below)
EMPTY_TOKS	If TRUE then empty tokens are recognized By default EMPTY_TOKS=FALSE	EMPTY_TOKS=FALSE
LABELS-SC	Display Labels on Strip chart displays	LABELS-SC = AirTmp
LABELS-TAB	Display Labels on Tabulated displays (see section on displays labels next page)	LABELS-TAB = Precipitation

Backslash ('\') Codes

Code	LabVIEW Interpretation
\00 - \FF	Hex value of an 8-bit character; must be uppercase
\b	Backspace (ASCII BS, equivalent to \08)
\f	Form feed (ASCII FF, equivalent to \0C)
\n	Linefeed (ASCII LF, equivalent to \0A)
\r	Carriage return (ASCII CR, equivalent to \0D)
\t	Tab (ASCII HT, equivalent to \09)
\s	Space (equivalent to \20)
\\	Backslash (ASCII \, equivalent to \5C)

Backslash codes can be used in the Keys: CMD and DELIMITERS as well as in a output module section with the FORMAT statement (Section 9.4.0).
A backslash placed at the end of a line will append the following line.

The CMD key name specifies the command that is sent to the module. If a module has an address of SWR01 and a attention character of "#" and an additional command Of "C" then the CMD line would be CMD = #SWR01C
The attention character is the character that the module recognizes as the attention character. It is usually a '#' but it can sometimes be '$' or '!'.

You can use backslash codes in the CMD command. Some modules require a terminating character on the end of the command string which is usually a carriage return. You can specify this with the '\r' character. E.g. CMD = #x\r where x is the module address/command. If the module requires binary addresses and/or commands then use the backslash hex value. Only two hex characters can be specified per backslash. For more hex characters just keep adding backslashes and two hex characters. E.g. CMD = #\F0\01\E4\0A This sends the 32 bit binary integer F001E40A to the module.

Some modules can get data from more than one addressable source. In this case the source must be specified for each input parameter.
Key names CMD, MSP, RANGE, UNC_RANGE, ADCAL and COR can be individually set for each source of data by appending a numeric identifier.
CMD = (first input parameter)
CMD2 = (second input parameter)
CMD3 = (third input parameter)
In these cases it is required that the key names CMD, MSP, and COR be individually specified. Key names RANGE, UNC_RANGE, ADCAL are usually optional.

Display Labels
The total character length of upper display indicators of strip chart displays is 14. The default labels can be changed using the key LABELS-SC. The character length of the labels should be no more than 6. The total character length of the display indicators of the tabulated displays is 24. These labels can be changed using the key LABELS-TAB. The character length of these labels should be no more than 14. In all cases the labels will be truncated if the label length plus value length exceeds available space. When using the keys, be sure to state a label for each parameter in the correct order. E.g.
LABELS-SC = LwrDM, LwrBD, LwrTP, LWR

9.3.1 MSP Module Setup Parameters

1 Port Number	0-Disable port 1-Port number.
2 Input Device type	0-RS485 Sensor Module 1-RS485 DGH Module 3-RS232 Continuous Serial Data 4-Time Server 6-SBE21 TSG Unit 7-Simrad EM VRU 8-NMEA message 10-Hippy 120 VRU
3 Internal use	0-Normal
4 Internal use	0-Normal
5 Termination character	Decimal value of the terminating character of the data returned from sensor. 10-Normal, 3 if using ALDEN IMET Module.
6	Number of milliseconds to wait for an RS485 device to release bus. 0-Normal
7	Number of variables returned from sensor (8 Max)
8	Index for variable #1
9	Index for variable #2
10	Index for variable #3
11	Index for variable #4
12	Index for variable #5
13	Index for variable #6
14	Index for variable #7
15	Index for variable #8
1 Port Number	0-Disable port 1-Port number.
2 Input Device type	0-RS485 Sensor Module 1-RS485 DGH Module 3-RS232 Continuous Serial Data 4-Time Server 6-SBE21 TSG Unit 7-Simrad EM VRU 8-NMEA message** 10-Hippy 120 VRU
3 Internal use	0-Normal
4 Internal use	0-Normal
5 Termination character	Decimal value of the terminating character of the data returned from sensor. 10-Normal, 3 if using ALDEN IMET Module.
6	Number of milliseconds to wait for an RS485 device to release bus. 0-Normal
7	Number of variables returned from sensor (8 Max)
8	Index for variable #1
9	Index for variable #2
10	Index for variable #3
11	Index for variable #4
12	Index for variable #5
13	Index for variable #6
14	Index for variable #7
15	Index for variable #8

When determining index numbers, input values are delimited only by recognized delimiters. Delimiters may be specified as per section 9.3.0. Defaults are spaces, commas, tabs and carriage returns. Line feeds are delimiters if they are not specified as terminating characters.

Empty Tokens are treated differently depending on whether the input data is a NMEA message or coming from a non-NMEA source.
1. NMEA messages – In a NMEA message all tokens are recognized whether they are empty or not.
2. non-NMEA input strings – If using the default value for DELIMITERS then Tokens are recognized only if they contain data.

For example, if an input string from a non-NMEA source contains the following line
24.0,,,45.9,,,23.0
If using the default value for DELIMITERS then the values are indexed as follows:
1-24.0 2-45.9 3-23.0

In a NMEA message the same input string is indexed as follows:
1-24.0 4-45.9 7-23.0

If you specify “DELIMITERS =” without the ‘\s’ character then empty tokens are recognized. Or if you specify EMPTY_TOKS=TRUE then empty tokens are also recognized so that a non-NMEA source will be indexed he same way that NMEA message is parsed.

Consider the following string that could be received from a module. If it is an Air temperature module and the actual set of values are returned are:
1000, 25.0 60.0 10.0<cr><lf>
Count, Air Temperature, R1value, R2value
Then the correct index number is 2 as it selects the second item in the string as air temperature.

**NMEA messages that can be input to the MET program are:
GGA, VTG, GLL, RMC, HDT, ZDA, MWV, DBT and PASHR ATT (SHR)
Specify the selected NMEA message(s).
Example 1:
CMD = GGA VTG ZDA
Example 2:
CMD=RMC

NMEA	MET Parameters extracted
GGA	LA LO GT
VTG	CR SP
GLL	LA LO GT
RMC	LA LO CR SP GT ZD
HDT	GY
ZDA	ZD
MWV	WS WD
DBT	BT
SHR	SH

9.3.2 MCP Module Calibration Parameters

1	0-Calibrations not applied in Acquisition program 1-Calibrations applied in Acquisition program
2	0-Calibrations not applied in MET sensor Module 1-Calibrations applied in MET sensor Module
3	3-Number of parameters to be computed from the returned variables
4	Calibration method for A/D correction
5	Calibration method for parameter #1
6	Calibration method for parameter #2
7	Calibration method for parameter #3
8	Calibration method for parameter #4
9	Calibration method for parameter #5
10	Calibration method for parameter #6
11	Calibration method for parameter #7
12	Calibration method for parameter #8

9.3.3 Calibration Method types

0-None
1-Offset Result = X+offset
2-Offset(360Deg)Result = X+offset
3-Slope, Offset Result = (X+offset)*slope
4-Polynomial Result = X+AX2+BX+C (2-10 coefficients)
5-Polynomial Result = AX2+BX+C (2-10 coefficients)
6-Polynomial Result = X+AX2+BX+C+DT (2-10 coefficients)
7-Polynomial Result = AX2+BX+C+DT (2-10 coefficients)
8-LWR calculation (Tbody, Tdome, microvolts)
9-Thermistor resistance to temperature calculation from A B C coeffs.
Excitation volts, series resistance, A, B, C, Slope, offset
10-RTD resistance to temperature Calculation from Rtp Rga Rrtd
11-Seabird T
12-Seabird C
13-Slope, Offset Result = (X*slope+offset) * Y
14-Slope, Offset, DT (Weatherpak BP cal)
15-Dew Point Calculation from HRH
16-Seawater Salinity Calculation From TSG
17-Seawater Density Calculation From TSG
18-Seawater Sound Velocity Calculation From TSG
19-True Wind Speed Calculation From Relative Wind
20-True Wind Direction Calculation From Relative Wind
21-Seawater Oxygen Calculation From SBE13
22-Seawater Oxygen Calculation From SBE43
23-Oxygen Saturation value of Seawater
24-Beam Attenuation from slope, offset, path length (meters)
25-pH from SBE-18 slope, offset
30 – Formula mode (See following paragraph on Formula mode)

Notes:
Sensor Type OXY should always be calibrated to ml/l.
Sensor Type WND should always be calibrated to M/S.
Sensor Type FLW should always be calibrated to LPM.

Refer to section 11 for information on calculation methods.

Formula Mode:

Using the Keyword <EVAL> enter in the mathematical equation that is needed to compute the desired result. There are predefined variables to use:

Variable	Meaning
x	Current value returned by the module
a thru t	Coefficients defined in the COR= statement
v1 thru v7	Previously calculated results
at bc st tt ax	MET primary parameter as defined in Appendix A

For example if the module section includes the following statements:
EVAL = x*a+b
COR = 50.0, 7.0

The variable a will refer to the first coefficient; variable b will be the next coefficient. So if the raw value returned by the module equals 2.5 then the result will be
(2.5*50+7) which equals 132.0

If the module returns two values and the result of the second result depends on the value of the first result then use the keyword to refer to the second expression:
EVAL2 = x+a/b*c+v1
COR2 = 2.0 , 5.0, 8.0

In this case if the module returns the values 2.5 and 6.0 then the result of the second computed value will be (6+2/5*8+132) = 141.2

Constants can be included in the equations as long as they are not expressed in scientific notation.
Correct use of constants: EVAL = x * 0.001
Incorrect use of constants: EVAL = x * 1e-3

If a constant needs to be expressed in scientific notation then make it a coefficient and refer to it as a variable such as:
EVAL = x*a
COR = 1e-3

Functions such as sin, cos, tan, sqrt can also be used such as:
EVAL = sqrt(x) * a + b

The following operators can be used:

+ and -	addition and subtraction
* and /	multiplication and division
^	exponentiation

Formula Mode Functions

Function	Description
abs(x)	Returns the absolute value of x.
acos(x)	Computes the inverse cosine of x in radians.
acosh(x)	Computes the inverse hyperbolic cosine of x.
asin(x)	Computes the inverse sine of x in radians.
asinh(x)	Computes the inverse hyperbolic sine of x.
atan(x)	Computes the inverse tangent of x in radians.
atanh(x)	Computes the inverse hyperbolic tangent of x.
ceil(x)	Rounds x to the next higher integer (smallest integer x)
ci(x)	Computes the cosine integral of x where x is any real number.
cos(x)	Computes the cosine of x, where x is in radians.
cosh(x)	Computes the hyperbolic cosine of x.
cot(x)	Computes the cotangent of x (1/tan(x)), where x is in radians.
csc(x)	Computes the cosecant of x (1/sin(x)), where x is in radians.
exp(x)	Computes the value of e raised to the x power.
expm1(x)	Computes one less than the value of e raised to the x power ((e^x) – 1).
floor(x)	Truncates x to the next lower integer (largest integer x).
gamma(x)	(n + 1) = n! for all natural numbers n
getexp(x)	Returns the exponent of x.
getman(x)	Returns the mantissa of x.
int(x)	Rounds x to the nearest integer.
intrz(x)	Rounds x to the nearest integer between x and zero.
ln(x)	Computes the natural logarithm of x (to the base of e).
lnp1(x)	Computes the natural logarithm of (x + 1).
log(x)	Computes the logarithm of x (to the base of 10).
log2(x)	Computes the logarithm of x (to the base of 2).
sec(x)	Computes the secant of x, where x is in radians (1/cos(x)).
si(x)	Computes the sine integral of x where x is any real number.
sign(x)	Returns 1 if x > 0, returns 0 if x = 0, and returns –1 if x < 0.
sin(x)	Computes the sine of x, where x is in radians.
sinc(x)	Computes the sine of x divided by x (sin(x)/x), where x is in radians.
sinh(x)	Computes the hyperbolic sine of x.
sqrt(x)	Computes the square root of x.
tan(x)	Computes the tangent of x, where x is in radians.
tanh(x)	Computes the hyperbolic tangent of x.

9.3.4 Examples of setting up an Input Module section

Example #1
The Eppley acquires thermopile data from a millivolt to RS485 converter. The Body and Dome temperature values are acquired from a different RS485 converter. If values come from more Than one source then use the CMD and MSP Keys for each source. First source use CMD, 2nd source use CMD2, 3rd source use CMD3. Default Tags and precision are used so they do not need to be specified.

```
[LWR00]
SENSOR = Long Wave Radiation
MODEL = PIR
SERIAL = 29929F3
MFG = Eppley Labs
CAL_LAB = Eppley
CAL_DATE = 25-SEP-02
LOCATION = Forward MET Mast (TOP)
OWNER = SIO/STS
# DGH D2102 0-10mv VDC (Thermopile)
# DGH D5132 0-5v VDC  (Dome Temp, Body Temp)
CMD = #p\r
CMD2 = #q\r
CMD3 = #m\r
# Module setup parameters
MSP = 3 1 0 0 10 0 1  1 0 0 0 0 0 0 0
MSP2 = 3 1 0 0 10 0 1  1 0 0 0 0 0 0 0
MSP3 = 3 1 0 0 10 0 1  1 0 0 0 0 0 0 0
MCP = 1 1 4 3  9 9 3 8 0 0 0 0
# Emulation values
Emulation = 1200 1200 114.7
AVGTYPE=1 1 1 1
SECSTOAVG=10.0
# A/D Calibration
ADCAL = 0.001, 0.0
# Dome, Body, Thermopile
# Corrections for Dome Glass Temp sensor
COR = 10.0, 82500, 0.0010295, 0.0002391, 1.568e-7, 1.0, 0.0
# Corrections for Body Temp sensor
COR2 = 10.0, 82500, 0.0010295, 0.0002391, 1.568e-7, 1.0, 0.0
# Eppley correction factors
# Thermopile Slope Offset (in uv)
COR3 = 1000.0, 0.0
# Eppley factor, Stefan-Boltzmann Const, absorption/dome glass IR
# Cal Factor 3.65e-6 volts/watts meter -2
COR4 = 3.78e-6, 5.6697e-8, 1.97
```

```
# Serial Port and Sensor Configuration section
UNIT3   1 COMM3  9600 NONE 8 1   RS485 – LWR Sensor
```

Example #2
Suppose you have a fluorometer that outputs RS232 data at 9600 baud and you want to connect to to the MET PC comm port #3. No calibration factors applied by the program. You are interested only in logging the corrected fluorescence and turbidity.

The sensor outputs the following data stream:
Turner SCUFA II (PCdate, PCtime, Raw-fluorescence, Temp-corr-fluorescence, Turbidity, Uncalib-temperature)
02/28/01 15:11:45 13.502 13.807 0.410 26.6<cr><lf>

First, identify the sensor type as a Fluorometer then assign a unique two-number Sensor ID. From section 2 you find that the fluorometer is type FLU. Then assign a unique two-number code (E.g. FLU11). Only one defined sensor of each type is allowed. It is not permissible to have more than one FLU11 in the system.

Enter the new Sensor as [FLU11]. Then enter information about the sensor.

```
 [FLU11]
SENSOR = Fluorometer
MODEL = SCUFA II
SERIAL = 12345
MFG = Turner
CAL_LAB = Turner
CAL_DATE = 01-FEB-2003
LOCATION = AFT LAB – Revelle
OWNER = MLRG
COMMENTS = Used on Calcofi Cruise Feb-2003
# For an RS232 port “CMD = “ must be Zero
CMD = 0
# Module setup parameters
# 1 serial port unit number.  2 Device – RS232 Port
# 3, 4 – 0                    4 Termination character (decimal value) – 10 (Line Feed)
# 5 – 0                       6 – Number of values returned
# 7 Index number of Fluorometer value (3rd position in string)
# 8 Index number of Turbidity value (4th position in string)
# 9-14 unused
MSP = 4 3 0 0 10 0 6  3 4 0 0 0 0 0 0
MCP = 0 1 2 0  0 0 0 0 0 0 0 0
# Since the default tag setting is FL then in order to acquire both FL and TB it is
# necessary to overide the defaults then the Precision also needs to be specified.
TAGS-R = FL TB
TAGS-C = FL TB
PRC-R = 3 3
PRC-C = 3 3
EMULATION = 13.502 0.410
ADCAL = 1.0 0.0
COR = 1.0, 0.0
COR2 = 1.0, 0.0

# Serial Port and Sensor Configuration section
UNIT4   1 COMM4  9600 NONE 8 1   RS232 Input - SCUFA II Fluorometer
```

9.4.0 Output Module Setup Section

In addition to the standard output Data files (section 10) and standard pre-defined serial data output formats that are described in section 8 it is possible to generate custom user defined output data format(s). These defined formats are specified in an output module section of the ACQ file. Data can be output to any number of available serial ports and/or written to any number of user files. For each defined output module, a separate user file is written and/or a separate message is output to a serial port. Any number of user defined output modules can be specified for most kinds of desired outputs. So it is possible to output different messages out different serial ports and/or written to different files. Output modules are specified in the .ACQ file in a section that starts with OUT followed by two identifier digits. The first defined output module will be setup in a section called OUT01.

Output Module Key names

Keys	Description	Example
SERUNITNUM	Serial Output Unit Number 0 – Disable Serial Output >0 Enable Serial Output on designated UNIT. If Serial output is enabled: In the Serial Port configuration section in the column just after UNIT# set function to 20	SERUNITNUM=2 Output data on port designated by Unit #2 Function for Unit#2 Set Function to 20
PARAMETERS	MET Parameter tag (from Appendix A)	PARAMETERS=AT BP LA LO
PARAMETER NUMBERS	MET Parameter Sensor number 0 – First sensor 1 – Second Sensor 2 – Third Sensor (and so on)	PARAMETER NUMBERS= 0 0 0 0
PRECISION	Number of decimal places for each parameter	PRECISION=3 3 5 5
INTERVAL	Time Interval (in seconds that data is either Stored in a file and/or output to a serial port	INTERVAL=10.0
MK_OUTFILE	Enables/Disables writing the selected data to a USER File	MK_OUTFILE=TRUE
ADDCRC	Enables/Disables Addition of NMEA style Checksum to end of line	ADDCRC=TRUE
ADDTIMESTAMP	Enables/Disables Time stamp at the beginning of each line	ADDTIMESTAMP=TRUE
LEADER	Specify any desired leader string	LEADER=$WIUSER
NMEA	Specify one or more standard NMEA message(s) to include in the output. If no NMEA messages are desired then do not specify this key. NMEA messages that can be output: GGA, GLL, RMC, VTG, ZDA, HDT, DBT, MWD, MTW and XDR	NMEA=GGA VTG ZDA
DELIMITERS	Delimiters may be any character or several characters or any of the backslash codes Described in Section 9.3.0	DELIMITERS = , Or DELIMITERS = \s
FORMAT	Output FORMAT syntax.	FORMAT = %6.3f %.4f

The FORMAT keyword, if defined, overides the PRECISION and DELIMITERS keywords. Data is output according to the defined syntax.

%[–][+][^][0][Width][.Precision][{unit}]Conversion Code

The conversion code can be “e, f or g”

f floating-point number with fractional format (for example, 12.345)

e floating-point number in scientific notation (for example, 1.234E1)

g floating-point number using e format if the exponential is less than –4 or greater than Precision, or f format otherwise

Data is formatted using a ‘C’ like format specifier string such as you would see in a “printf” statement. An example would be:
PARAMETERS = AT, BP, RH
FORMAT= Air Temperature %7.3f Deg C\tBP %7.2f mb\tHumidity %5.2f Percent

Alternately, each parameter grouping can be separated by the ‘|’ character. This is desired when outputting parameters such as latitude, longitude and time in something other than a decimal format (See below). The vertical bar, if used, must be placed around all parameter format specifiers.
FORMAT = %7.3f |%2.4f | %2.1e

Using FORMAT, values are not automatically delimited. The DELIMITER keyword has no effect in this mode. It is necessary to include delimiters in the FORMAT statement. Delimiters may be backslash codes to indicate TABS or SPACES or any desired character. SPACES can be either ‘\s’ or ‘ ‘.

The ‘|’ ‘%’ characters have special meaning. However, if is desired to put these characters in the output string use the backslash codes as described in Section 9.3.0.
\7C represents the ‘|’ character.
\25 represents the ‘%’ character.

Generally there is only one format specifier per selected parameter. Such as, for the parameter AT you might use a format specifier of %4.1f. The exceptions can be for parameters for time(GT, TS, ZD, SY), latitude(LA) and longitude(LO). For time parameters use one format specifier e.g. %.1f to output the time in floating point format (time of seconds since 1970) or use special format codes to format the time parameter in a particular format. If, for example, it is desired to output time in hours, minutes, seconds 23:56:00. Use %H:%M:%S. The below table shows the format codes that can be used to format time parameters.

If latitude specified in decimal format is desired then use one format specifier e.g. %.5f. Otherwise if latitude expressed in degrees and minutes is desired then use additional format specifiers along with the vertical bar ‘|’ as follows:
Latitude %02.0f %06.3f%1s| Longitude %03.0f %06.3f%1s

This produces:
Latitude 32 30.042N Longitude 117 30.042W

Format Codes for the Time Format String

Format Code	Value
%%	a single percent character
%a	abbreviated weekday name (e.g. Wed)
%A	full weekday name (e.g. Wednesday)
%b	abbreviated month name (e.g. Jun)
%B	full month name (e.g. June)
%c	locale's default date and time representation
%d	day of month (01–31)
%H	hour (24-hour clock) (00–23)
%I	hour (12-hour clock) (01–12)
%j	day number of year (001–366)
%m	month number (01–12)
%M	minute (00–59)
%p	AM or PM flag
%S	seconds (00–59)
%<digit>u	fractional seconds with <digit> precision
%U	week number of the year (00–53), with the first Sunday as the first day of week one
%w	weekday as a decimal number (0–6), with 0 representing Sunday
%W	week number of the year (00–53), with the first Monday as the first day of week one
%x	locale's date representation
%X	locale's time representation
%y	year within century (00–99)
%Y	year, including the century (for example, 1997)
%Z	time zone name or abbreviation, depending on the operating system locale settings

The following are some examples of an output module section.

Example#1

```
[OUT01]
SERUNITNUM = 2
PARAMETERS= AT BP RH LA LO
PARAMETER NUMBERS = 0 0 0 0 0
PRECISION = 3 3 3 5 5
MKOUTFILE = TRUE
INTERVAL = 10.0
ADDCRC = TRUE
ADDTIMESTAMP = TRUE
LEADER = $WIUSR
NMEA = GGA, VTG, ZDA
```

This will produce an output that looks like:

```
$WIUSR,180000,20.000,1010.000,80.123,32.12345,-117.12345*A0
$GPGGA,225531.811,3241.3954,N,11708.6334,W,1,08,1.4,033.1,M,036.0,M,,*7F
$GPVTG,000.0,T,346.8,M,000.0,N,000.0,K*47
$GPZDA,225533.00,21,03,2003,00,00,*4B
```

If ADDTIMESTAMP is TRUE then the time will be placed just before the data and just after the leader string. If there is no leader then the time will be at the beginning. Of each line. All above four lines of data will be output on Serial Port#2 every 10 seconds. This will also be written to a file in the data directory every 10 seconds.

Example #2

```
[OUT02]
SERUNITNUM = 3
PARAMETERS= AT BP RH LA LO GY SP
PARAMETER NUMBERS = 0 0 0 0 0 0 0
PRECISION = 3 3 3 5 5 1 1
MKOUTFILE = FALSE
INTERVAL = 5.0
ADDCRC = FALSE
ADDTIMESTAMP = FALSE
```

This will produce an output that looks like:

```
25.123,1010.000,75.000,32.12345,-117.12345,270.0,10.0
```

In this case, data goes out port#3 every 5 seconds. No NMEA messages, Data not written to file. No leader, no timestamp and no Checksum.

Example #3 Using the Format Keyword

```
[OUT02]
SERUNITNUM = 3
PARAMETERS= AT BP RH LA LO GY SP
PARAMETER NUMBERS = 0 0 0 0 0 0 0
MKOUTFILE = FALSE
INTERVAL = 5.0
ADDCRC = FALSE
ADDTIMESTAMP = FALSE
FORMAT = AT: %7.3f BP: %6.1f  RH: %.2f LA: %.4f LO: %.4f GY: %5.1f SP: %4.1f
```

This will produce an output that looks like:

```
 AT: 25.123 BP: 1010.0 RH: 75.00 LA: 32.1234 LO: -117.1234 GY: 270.0 SP: 10.0
```

For each defined output module a different file name will be assigned. For the first defined output module the file name will be something like 030401.M00. For each additional output that may be defined the number will increment by one. E.g. a second defined output module will be 030401.M01

All data will always be written to the standard data files regardless of (if or how) any output modules are defined or specified. The standard data files are described in the next section.

Example #4 Outputting data in Seabeam 2000 format

(This is only an example. To output to Seabeam it is recommended to use the serial output codes in Section 8)

```
[OUT03]
SERUNITNUM = 0
PARAMETERS= ZD, LA, LO, SP, GY, TT
PARAMETER NUMBERS = 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0
MKOUTFILE = TRUE
INTERVAL = 1.0
ADDCRC = FALSE
ADDTIMESTAMP = FALSE
FORMAT = $M2:%y%m%d%H%M%SGP1W84 |%02.0f-%06.3f%c|%03.0f-%06.3f%cGG*DDD.D| \
                    %4.1f |%5.1f |%+5.1f*MMMM
```

The above will produce an output like:

```
$M2:030413115640GP1W84 32-20.736N117-34.068WGG*DDD.D 12.0  90.0 +20.0*MMMM
```

Since time, latitude and longitude are desired in a non-decimal form then the vertical bar must be used to group each parameter.

* Note that the backslash ‘\’ placed at the end of the line will append the following line. Leading white space on the following line and the backslash is discarded.

10. Data File Format

10.1.0 MET data file format description

The acquisition program generates at least two files. One file is corrected data, which is the sensor return value that has calibration corrections applied within the acquisition program. The other file is uncorrected data which is the sensor return value unaltered by the program. The corrected data file is of type .MET. The Uncorrected data file is of type .UCR. If enabled, the program will also generate additional files written in the Translator format. These files are of type .COR and .UNC.
Data files start upon program execution or at the beginning of each (GMT) day beginning at 0000Z. At the end of the day at 2359Z the file is closed and a new set of files start again at 0000Z the next GMT day.

MET, UCR Files:
Four lines of header information begin the file
1. Shipname title information
2. Date, Time
3. Data type - Uncorrected or Corrected data
4. Header - Each data parameter is identified using this line

An abbreviated example of a MET corrected data file follows:

```
# R/V New Horizon Meteorological Data Center
# Fri 16-Aug-2002 19:37:22
# Met Data - Corrected
#Time      AT       BP       WS       WD       RH       LA       LO       CR       SP
193722  30.03    1002.94  6.0      10.0     70.43    32.345600 -117.567800 45.0     10.0
193752  30.03    1002.94  6.0      10.0     70.43    32.345600 -117.567800 45.0     10.0
193822  30.03    1002.94  6.0      10.0     70.43    32.345600 -117.567800 45.0     10.0
```

An abbreviated example of a UCR uncorrected data file follows:

```
# R/V New Horizon Meteorological Data Center
# Fri 16-Aug-2002 19:37:22
# Met Data - Uncorrected
#Time      AT       BP       WS       WD       RH       LA       LO       CR       SP
193722  0.70000  3.70000  6.00     10.00    0.70000  32.345600 -117.567800 45.0     10.0
193752  0.70000  3.70000  6.00     10.00    0.70000  32.345600 -117.567800 45.0     10.0
193822  0.70000  3.70000  6.00     10.00    0.70000  32.345600 -117.567800 45.0     10.0
```

The order that each sensor data is stored is determined in the Module selection section in the acquisition and calibrations setup file (See section 9.1).
The precision of any stored data point is determined by use of the PRC key name (Section 9.3.0).
The header line in the MET and UCR files use a two-character parameter ID to identify the data.
If, for example, a second air temperature sensor were added, it would be identified in the header as AT-2 (See Appendix A).

COR, UNC Files:
The .COR and .UNC files are in the DOS translator format and are used in those applications that expect the MET data to be in this format.
These files will only be generated if enabled in the [GENERAL] section of the ACQ file.
[GENERAL]
MK_COR = TRUE
MK_UNC = TRUE

An abbreviated example of a Translator COR corrected data file follows:

```
$WICOR,020902,140316,30.03,AT8,1002.94,BP8,6.0,WS8,10.0,WD8,70.43,RH8,32.345600,LA8,
-117.567800,LO8,45.0,CR8,10.0,SP8*06
$WICOR,020902,140346,30.03,AT8,1002.94,BP8,6.0,WS8,10.0,WD8,70.43,RH8,32.345600,LA8,
-117.567800,LO8,45.0,CR8,10.0,SP8*06
```

An abbreviated example of a Translator UNC uncorrected data file follows:

```
$WIUNC,020802,140316,0.70000,AT8,3.70000,BP8,25.00,BC8,6.00,WS8,10.00,WD8,0.70000,RH8,0.70000,RT8
,32.345600,LA8,-117.567800,LO8,45.0,CR8,10.0,SP8*10
$WIUNC,020802,140346,0.70000,AT8,3.70000,BP8,25.00,BC8,6.00,WS8,10.00,WD8,0.70000,RH8,0.70000,RT8
,32.345600,LA8,-117.567800,LO8,45.0,CR8,10.0,SP8*10
```

The WICOR and WIUNC files contain Data Corrected and Data Uncorrected files respectively. The file name indicates the date (yymmdd) plus the extension .COR for corrected data or .UNC for uncorrected. Each line begins with the title $WICOR or $WIUNC to identify corrected or uncorrected data, followed by the date (ddmmyy) and time (hhmmss). The MET sensor data follows in the sequence it was acquired as specified in the sensor enable section. The data is followed by latitude, longitude, course, speed and gyro. Each data point in the .COR and .UNC files has a 2 character ID to identify it. There is also a third character to help clarify the type of data. E.g. +25.3,AT0 (air temperature, calibrations not applied).
0 - Calibration coefficients not applied
1 - Calibration coefficients applied in Sensor Module
2 - Calibration coefficients applied in Acquisition computer
3 - Calibration coefficients applied in Sensor Module and Acquisition computer
7 - Data Out of Range
8 - Data is Emulated (Not Real)
9 - Data invalid

Any data file can be used to regenerate a file of another type when in PLAYBACK MODE. For example when playing back a file of type .UCR you can generate files of type .MET, .COR and .UNC. When playing back of type .MET you can generate a file of type COR. When in PLAYBACK MODE be sure to enable the FILE WRT Control in the control panel after selecting the data file to playback.

10.2.0 MET log file description

When MK_LOG is set to TRUE the program will generate a log and status file one every day at about 2200 GMT. This file gives information on sensor operational status, sensor configuration, the source of MET parameters and information on what parameters are written to the data files. It also indicates the currently selected .ACQ setup/configuration file and active sensor modules.

The file name is of type .LOG.
when MK_LOG is set to TRUE the program makes a copy of the currently selected .ACQ file to the filename of type .ACQ.

If the program wrote data and log files on April 27, 2003 the file names would be
030427.MET Corrected data file
030427.UCR Uncorrected data file
030427.ACQ Copy of currently selected setup/cal file
030427.LOG Met system LOG and status file

11. MET System Calculation Methods.

MET sensor parameters are calibrated to output data in units according to the MET parameter list in appendix A. Raw data from sensors are usually corrected using either slope/offset or polynomial corrections using coefficients obtained from sensor calibration sheets. Some parameters are calculated using oceanographic or atmospheric algorithms. These parameters include seawater salinity, density, sound velocity, oxygen; true wind speed/direction, dew point and long wave radiation.

Surface Seawater calculations:
Seawater Temperature data that are displayed and recorded in data files are calibrated to *ITS(T90). Seawater Salinity calculations in *PSU are derived according to *PSS 1978 using *TSG temperature and conductivity values. Surface seawater sound velocity (M/S) calculations are made using TSG temperature and TSG salinity values according to the Chen/Millero 1977 equation. Seawater oxygen values are calculated using oxygen temperature, oxygen current, oxygen saturation and seawater salinity values. Oxygen saturation is first calculated, then oxygen is calculated to ml/l. Seawater temperature is converted internally to *ITS(T68) prior to calculating salinity, density, sound velocity and oxygen. References in section 11.1.0.

*Thermosalinograph(TSG)
*Practical Salinity Units
*PSS 1978 Practical Salinity Scale 1978
*ITS(T68) International Temperature Scale of 1968 ITS-68
*ITS(T90) International Temperature Scale of 1990 ITS-90

Wind Calculations:
Wind Direction is defined as the direction from which the wind is coming from.

True Wind Speed and direction are calculated using relative wind speed, relative wind direction, Ship’s heading (Gyrocompass), Ships course (GPS COG) and Ships speed (GPS SOG). All wind corrections and True wind calculations are applied and computed prior to doing any averaging. Averaging (if enabled) is then performed on the individual components of relative wind speed/direction and true wind speed/direction. True Wind calculations are computed according to the WOCE-MET publication on True Winds listed in the References in section 11.1.0.

Dew Point Calculation:
Dew point is calculated using relative humidity, air temperature and barometric pressure.

Long Wave Radiation (Pyrgeometer):
LW irradiance in W m^{-2} is calculated using thermopile volts, body temperature, dome temperature and calibration factor from instrument calibration sheet.
References in section 11.1.0.

11.1.0 REFERENCES

Surface Seawater Salinity

Lewis, E. L., 1980. The Practical Salinity Scale 1978 and Its Antecedents. IEEE Journal of Oceanographic Engineering,OE-5, 3-8.
Culkin, F. and Smith, N. D., 1980. Determination of the Concentration of Potassium Chloride Solution Having the Same Electrical Conductivity, at 15C and Infinite Frequency, As Standard Seawater of Salinity 35.0000ppt (Chlorinity 19.37394ppt), IEEE Journal of Oceanographic Engineering, Vol. OE-5, No. 1.
UNESCO, 1981, Background Papers and Supporting Data on the Practical Salinity Scale 1978, Technical Papers in Marine Science, No. 37.

Surface Seawater Sound Velocity

Millero, F.J. and Li, X., "Comments on 'On equations for the speed of sound in seawater'" 1994,JASA,95,2757-2759. Chen & Millero, 1977,JASA,62,1129-1135.

Surface Seawater Density

Millero, F. J., Chen, C. T., Bradshaw, A. and Schleicher, K., 1980 A New High Pressure Equation of State for Seawater. Deep-Sea Research 27A, 255-264.
Fofonoff, N. P. and Millard, R. C., 1983. Algorithms for Computation of Fundamental Properties of Seawater. UNESCO Report No. 44, 15-24.

Surface Seawater Oxygen

Seabird SBE43 Dissolved Oxygen Sensor Application Note No. 64
References Listed in Seabird Application Note No. 64
Gnaigner, E., and H. Forstner, Ed., 1983: Polarographic Oxygen Sensors: Aquatic and Physiological Applications, pringer-Verlag, 370 pp.
Millard, R, C., Jr., 1982: CTD calibration and data processing techniques at WHOI using the 1978 practical salinity scale. Proc. Int. STD Conference and Workshop, La Jolla, Mar. Tech. Soc., 19 pp.
Owens, W.B., and R.C. Millard Jr., 1985: A new algorithm for CTD oxygen calibration. J. Physical Oceanography, 15, 621-631.
Weiss, R.F., 1970: The solubility of nitrogen, oxygen and argon in water and seawater. Deep-Sea Res., 17, 721-735.

True Wind Calculations

Wind WOCE MET Calculations of True Winds.
Shawn R. Smith, Mark A. Bourassa, and Ryan J. Sharp, 1999: Establishing more truth in true winds, Published: December 99, Vol. **16**, pp. 939-952 Center for Ocean-Atmospheric Prediction Studies (COAPS).

Long Wave Radiation

Albrecht, B., and S. K. Cox. 1977. "Procedures for Improving Pyrgeometer Performance." *Journal of Applied Meteorology* 16:188-197
Fairall, C.W., P.O.G. Persson, E.F. Bradley, R.E. Payne, and S.P. Anderson, 1998. A new look at calibration and use of Eppley precision infrared radiometers. Part I: Theory and Application. *Journal of Atmosphere and Oceanic Technology*, 15, 1229-1242.
Payne, R.E. and S.P. Anderson, 1999. A new look at calibration and use of Eppley precision infrared radiometers. Part II: Calibration and use of the Woods Hole Oceanographic Institution Improved Meteorology Precision Infrared Radiometer. *Journal of Atmosphere and Oceanic Technology*, 16, 739-751.
Philipona, R., C. Frohlich, and C. Betz, 1995: Characterization of pyrgeometers and the accuracy of atmospheric long-wave radiation measurements. Applied Optics: Lasers, Photonics, and Environmental Optics, **34,** 1598–1605.

Dew Point

Saucier, W. J., 1955: *Principles of Meteorological Analysis*. University of Chicago Press, Chicago, 438 pp.

Appendix A MET Parameter Index

Number	Parameter	Description	Units
0	AT	Air Temperature	Deg C
1	BP	Barometric Pressure	mb
2	BC	Barometric Pressure Temp	Deg C
3	SW	Short Wave Radiation (SWR)	W/M^2 (Pyranometer)
4	LW	Long Wave Radiation (LWR)	W/M^2 (Pyrgeometer)
5	LD	LWR Dome Temperature	Deg K
6	LB	LWR Body Temperature	Deg K
7	LT	LWR Thermopile	Volts
8	PR	Precipitation	mm
9	PT	Precipitation	mm/hr
10	RH	Relative Humidity	%RH
11	RT	Air Temp (RH module)	Deg C
12	DP	Dew Point	Deg C
13	WS	Rel Wind Speed	M/S
14	WK	Rel Wind Speed	Knots
15	TW	True Wind Speed	M/S
16	TK	True Wind Speed	Knots
17	WD	Rel Wind Direction	Deg (Direction wind is coming from)
18	TI	True Wind Direction	Deg (Direction wind is coming from)
19	ST	Sea Surface Temperature	Deg C
20	TT	SBE21 Temperature	Deg C
21	TC	SBE21 Conductivity	mS/m
22	SA	Salinity	PSU
23	SD	Sigma-t	Kg/m^3
24	SV	Sound Vel (Chen/Millero)	M/S
25	OX	Oxygen	ml/l
26	OG	Oxygen	mg/l
27	OC	Oxygen Current	ua
28	OT	Oxygen Temperature	Deg C
29	OS	Oxygen Saturation value	ml/l
30	PH	Alkalinity (pH)	
31	FL	Fluorometer	ug/l
32	TB	Turbidity	NTU
33	TR	Transmissometer	%
34	BA	Beam Attenuation	
35	PA	Surface PAR	uE/Second/Meter^2
36	FM	USW Flow Meter	GPM
37	FI	USW Flow Meter	LPM
38	VT	Volts	Volts
39	MA	Current	m/a
40	WT	Auxiliary water Temp	Deg C
41	AX	Auxiliary Air Temperature	Deg C
42	PS	Pressure	PSI
43	XX	Unspecified	
44	LA	Latitude Decimal format	Deg
45	LO	Longitude Decimal format	Deg
46	CR	Ships Course (GPS COG)	Deg
47	SP	Ship’s Speed (GPS SOG)	Knts
48	SL	Ship’s Speed (Speed Log SOW)	Knts
49	GY	Ships Heading (Gyrocompass)	Deg

50	GT	GPS Time of Day	GMT Secs 0-86400
51	TS	Time Server Time of Day	GMT Secs 0-86400
52	ZD	GPS DateTime	GMT Secs Since 00:00:00 01/01/1970
53	SY	System DateTime	GMT Secs Since 00:00:00 01/01/1970
54	BT	Bottom Depth	Meters
55	SH	Ashtech Heading	Deg
56	SM	Ashtech Pitch	Deg
57	SR	Ashtech Roll	Deg
58	ZO	Winch Wire Out	Meters
59	ZS	Winch Speed	MPM
60	ZT	Winch Tension	LBS
61	VP	VRU Pitch	Deg
62	VR	VRU Roll	Deg
63	VH	VRU Heave	Meters
64	VY	Ship's List	Deg
65	VX	Ship's Trim	Deg
66	IP	CTD Depth	Meters
67	IT	CTD Temperature	Deg C
68	IS	CTD Salinity	PSU
69	IA	CTD Altimeter	Meters
70	IV	CTD Velocity	Meters/Sec
71	IX	Instrumentation Aux	

Appendix B NMEA-0183 Standard Sentence Formats

National Marine Electronics Association NMEA-0183 Standard Sentences

The Following NMEA-0183 Sentences can be utilized by the MetAcq Program.

$GPGGA - Global Positioning System Fix Data
$GPGLL - Geographic Position, Latitude/Longitude
$GPRMC - Recommended Minimum Specific GPS/TRANSIT Data
$GPVTG - Track Made Good and Ground Speed
$GPZDA - UTC Date / Time and Local Time Zone Offset
$HEHDT - Heading, True
$WIMWD - Wind Direction
$WIMWV - Wind Speed and Angle
$WIXDR - Transducer Measurements
$WIMTW - Water Temperature
$SDDBT - Depth Below Transducer

NMEA Talker Identifiers
GP – Global Positioning System (GPS)
GN – Global Navigation Satellite System (GNSS)
GL – GLONASS Receiver
HE – Heading Sensor, North Seeking
SD – Sounder, Depth
WI – Weather Instruments

$GPGGA Global Positioning System Fix Data

$GPGGA,180432.00,4027.027912,N,08704.857070, W,2,07,1.0,212.15,M,-3.81,M,4.2,0555*73

Field	Value	Meaning
1	180432.00	UTC of position fix in hhmmss.ss
2	4027.027912	Geographic latitude in ddmm.mmmmmm format
3	N	Direction of latitude (N - North, S - South)
4	08704.857070	Geographic longitude in dddmm.mmmmmm
5	W	Direction of longitude (E - East, W - West)
6	2	GPS quality indicator 0-fix not valid 1-GPS fix 2-DGPS fix 3-GPS PPS 4-RTK fixed Integers 5-RTK floating Integers 6-Deck Reckoning 7-Manual Input 8-Simulator Mode
7	07	Number of satellites in use (00-12)
8	1.0	Horizontal DOP
9	212.15	Antenna height above MSL (mean sea level) reference
10	M	Unit of altitude (meters)
11	-33.81	Geoidal separation (-33.81 m)
12	M	Unit of geoidal separation (meters)
13	4.2	Age of differential GPS data record
14	0555	Base station ID (0000-1023)

Each NMEA Sentence ends with a checksum delimeter “*” Followed by a two hexadecimal character checksum. The sentence terminates with <CR><LF>

$GPGLL Geographic Position – Latitude/Longitude

$GPGLL,4027.027912,N,08704.857070,W, 180432.00,A,D*7A

Field	Value	Meaning
1	4027.027912	Geographic latitude in ddmm.mmmmmm
2	N	Direction of latitude (N - North, S - South)
3	08704.857070	Geographic longitude in dddmm.mmmmmm
4	W	Direction of longitude (E - East, W - West)
5	180432.00	UTC of position fix in hhmmss.ss format
6	A	'A' shows that data is valid
7	D	Mode Indicator A-Autonomous M-Manual D-Differential S-Simulator E-Dead Reckoning N-Data Not Valid

$GPRMC Recommended Minimum Specific Data

$GPRMC,180432,A,4027.027912,N,08704.857070,W, 000.04,181.9,131000,1.8,W,D*25

Field	Value	Meaning
1	180432	UTC of position fix in hhmmss format
2	A	Status (A - data is valid, V - warning)
3	4027.027912	Geographic latitude in ddmm.mmmmmm format
4	N	Direction of latitude (N - North, S - South)
5	08704.857070	Geographic longitude in dddmm.mmmmmm
6	W	Direction of longitude (E - East, W - West)
7	000.04	Speed over ground knots
8	181.9	Track made good (heading-degrees)
9	131000	Date in ddmmyy format (October 13, 2000)
10	1.8	Magnetic variation -degrees
11	W	Direction of magnetic variation (E - East, W - West)
12	D	Mode Indicator A-Autonomous M-Manual D-Differential S-Simulator E-Dead Reckoning N-Data Not Valid

$GPVTG Course Over Ground and Speed Over Ground

$GPVTG,360.0,T,348.7,M,000.0,N,000.0,K,A*43

Field	Value	Meaning
1	360.0	Course Over Ground (COG), degrees TRUE
2	T	T-TRUE
3	348.7	Course Over Ground (COG), degrees MAGNETIC
4	M	M-MAGNETIC
5	000.0	Speed Over Ground (SOG), Knots
6	N	N-Knots
7	000.0	Speed over ground (SOG), km/hr
8	K	K-km/hr
9	A	Mode Indicator A-Autonomous M-Manual D-Differential S-Simulator E-Dead Reckoning N-Data Not Valid

$GPZDA Time & Date

$GPZDA,024611.08,25,03,2002,00,00*6A

Field	Value	Meaning
1	UTC Time	hhmmss.ss
2	UTC Day	01-31
3	UTC Month	01-12
4	UTC Year	yyyy (2002)
5	Local zone hours	Offset to local time zone in hours (00 to +/- 13)
6	Local zone Minutes	Offset to local time zone in minutes (00 to 59)

$HEHDT Heading, True

$HEHDT,180.0,T*6A

Field	Value	Meaning
1	180.0	Heading, Degrees True
2	T	TRUE

$SDDBT Depth Below Transducer

$SDDBT,1000.0,f,304.8,M,166.6,F*6A

Field	Value	Meaning
1	1000.0	Water Depth, Feet
2	f	f-feet
3	1000.0	Water depth, Meters
4	M	M-Meters
5	1000.0	Water Depth, Fathoms
6	F	F-Fathoms

$WIMWD Wind Direction & Speed

$WIMWD,90.0,T,90.0,M,10.0,N,6.0,M*6A

Field	Value	Meaning
1	90.0	Wind Direction, 0-359 degrees True
2	T	T-TRUE
3	90.0	Wind Direction, 0-359 degrees Magnetic
4	M	M-Magnetic
5	10.0	Wind Speed, Knots
6	N	N-Knots
7	6.0	Wind Speed, Meters/Second
8	M	M-Meters

$WIMWV Wind Speed & Angle

$WIMWV,90.0,R,10.0,N,A*6A

Field	Value	Meaning
1	90.0	Wind Direction, 0-359 degrees True
2	R or T	R-Relative T-Theoretical
3	10.0	Wind Speed
4	K/M/N	K-km/hour M-Meters/Second N-Knots
5	A or V	A-Data Valid V-Data Not valid

$WIXDR Transducer Measurements

$WIXDR,C,20.0,C,H,80.0,P,P,1.010,N,L,35.00,S*6A

Field	Value	Meaning
1	Type-C	C-Temperature
2	20.0	Air Temperature
3	Units-C	C-Degrees C
4	Type-H	H- Humidity
5	80.0	Relative Humidity
6	UnitsP	P-Percent
7	Type-P	P-Pressure
8	1.010	Barometric Pressure BARS
9	Units-B	B-Bars
10	Type-L	L-Salinity
11	35.0	Salinity PSU
12	Units-S	S-PSU

$WIMTW   Water Temperature

$WIMTW,20.0,C*6A

Field	Value	Meaning
1	20.0	Water Temperature
2	C	C-Degrees C

Appendix C Miscellaneous Message Formats

SeaBeam 2000 Navigation Message Format

Item	*Units*	*Length in bytes*	*Character Number*
Start of sentence	'$'	1	0
Message Recognition	'M2:'	3	1
Date	YYMMDD	6	4
Time	HHMMSS	6	10
System Selected	'GP1' (*Note 1*)	3	16
Datum	'W84'	3	19
Position Applicable Flag	(*Note 2*)	1	22
Latitude	DD-MM.MMM	9	23
Hemisphere	'N' or 'S'	1	32
Longitude	DDD-MM.MMM	10	33
Hemisphere	'W' or 'E'	1	43
Navigation System	'G' (*Note 3*)	1	44
Against (Water/Bottom)	'G' (*Note 4*)	1	45
Direction applicable flag	'*' (*Note 2*)	1	46
Ship Direction (Doppler)	'DDD.D' (*Note 5*)	5	47
Ship Speed Applicable flag	(Note 2)	1	52
Ships Speed	SS.S (Knots)	4	53
Direction Applicable flag	(*Note 2*)	1	57
Ship Direction (gyro)	DDD.D	5	58
Water Temp Applicable flag	(*Note 2*)	1	63
Water Temp. Sign	'+' or '-'	1	64
Water Temp.	DD.D (Celsius)	4	65
Depth Data Type	(*Note 6*)	1	69
Depth Data	MMMM (Meters)	4	70
EOM	<CR><LF>	2	74
Total Length		76	*Characters*

Note 1.This is a constant.
Note 2.This value is either a "*" (invalid) or " " (valid).
Note 3.This is a constant, set to GPS
Note 4.This is a constant as defined by SeaBeam and must be "G".
Note 5.This is not an available system
Note 6.This is not an available system

EM-120 Temperature, Sound Velocity Message Format
Surface SeaWater Temperature, Sound Velocity

20.00 1500.0

Field	Value	Meaning
1	20.00	Surface Seawater Temperature-Degees C (%7.2f)
2	1500.0	Surface Sound Velocity-Meters/Second (%7.2f)

Ashtech PASHR, ATT Attitude Message Format

$PASHR,ATT,153663.5,092.09,- 000.48,+000.04,0.0027,0.0103,0*20

Field	Value	Meaning
1	153663.5	GPS Receive time Seconds of week
2	092.09	Heading Degrees
3	-000.48	Pitch Degrees
4	+000.04	Roll Degrees
5	0.0027	MRMS (Measurement RMS error) Meters
6	0.0103	BRMS (Baseline RMS error) Meters
7	0	Attitude reset flag [0-Good 1-Invalid Value]
8	*20	NMEA Checksum value