

USER MANUAL 54

A Field Manual for Automated Water Level Recorders

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TWDB recorder in Val Verde County.

Introduction

The purpose of this manual is to provide basic operating knowledge of the components of the automated recorder (see Figure 1) used by the Texas Water Development Board (TWDB) for periodic water level measurement. Much more than just a supplement to the broader water level program, these automated recorders provide a means to document day-to-day changes and seasonal patterns in the aquifers of Texas that cannot be discerned from annual level readings. The design of these units also allows for remote satellite transmission of collected data, so that aside from installation and occasional maintenance, no additional work is required to obtain these measurements. This manual will primarily discuss the four major technical components of the automated recorder—the sensors, loggers, transmitters, and antennas—used by the TWDB for automated water level monitoring.

An automated groundwater recorder system is composed of six basic parts.

- 1) The **sensor** obtains the actual water level measurement. An optical sensor (or encoder—a measurement device that converts mechanical motion into electronic signals) uses a float and pulley system to obtain measurements, while a pressure sensor uses water pressure changes to get the data. Typically, older recorders use encoders, and newer ones are outfitted with pressure sensors/transducers.
- 2) The **logger (or data logger)** receives the data from the sensor and stores the measurements. This is the main unit that controls the system.
- 3) The **transmitter** receives data from the logger at scheduled intervals and transmits the information to a receiving site. TWDB recorders use the Geostationary Operational Environmental Satellite (GOES satellite) system to relay data, although some groundwater conservation district (GCD) programs use cell phone networks.
- 4) The **antenna** sends the signal to the GOES satellite.
- 5) The **power supply** generally consists of an absorbed glass mat (AGM) battery that is recharged with a solar panel.
- 6) The **shelter** protects the recorder from weather, animals, and most human-caused damage.

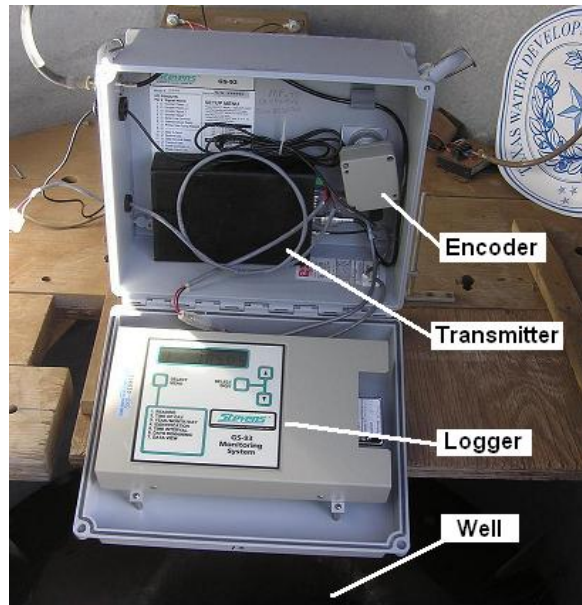


Figure1. A Stevens Recorder setup.

Equipment covered in this manual:

Sensors and A/F Recorders (A/F is Stevens' nomenclature for that particular version of the encoder and recorder.)

- Stevens A/F Encoder
- Dynotek Slimline Transducer

Loggers

- Stevens GS-93
- Stevens DOT Logger
- Sutron SatLink 2

Communication Units

- Sutron SatLink 2
- Stevens GHT

Antennas – general guide for the types used by TWDB

Recorder setups can vary greatly from site to site, and the TWDB also may assist cooperating agencies such as Groundwater Conservation Districts with recorders. Many of these may use different equipment than those discussed here (Figure 2), but a general idea of how these basic units function and work together can be enough to diagnose many maintenance problems.

Stevens Type A/F Encoder

This is a “shaft” type encoder in a protective metal enclosure with a tape and float and pulley (or line loop mounted on a pulley) (Figure 3). The tape loop hangs down the well, and a float mounted on the tape rests on the surface of the water in the well. A counterweight hung on the loop keeps it hanging straight and tight against the pulley. As the water level changes, the float rises or falls and causes the pulley to turn. An incremental optical sensor reads the movement of the tape and provides a quadrature output (indicating both relative change and direction of motion) to the logger. Thus the “technical” parts remain at land surface in the recorder shelter, with only the the well.

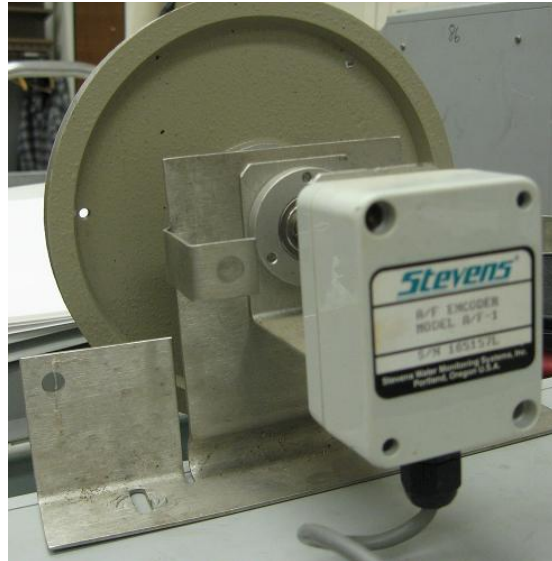


Figure 3. Stevens A/F Encoder

Specifications

Power: 5 volts direct current $\pm 10\%$ at 17 milliamp (mA) typical in continuous power mode; 3.5 mA typical when sampled by Stevens logger.

Cable: Power and signal output connections are made to a 4-conductor, shielded 5.5 foot cable; conductor size #22 American Wire Gauge (AWG) stranded wire.

Metal enclosure: Aluminum, protected by polyurethane paint; 2.45” x 2.2” x 1.3” (62mm x 56mm x 33mm)

Weight: 0.5 lb (0.23 kg)

Temperature: -40 to +160° F (-40 to +71° C)

Maintenance

Clean off any accumulated dust or debris regularly; check and replace desiccant when needed. Check that the pulley cable is freely hanging and easy to turn.

Stevens A/F Encoder Troubleshooting Table

Symptom	Problem or Action
Signal missing or intermittent	<ul style="list-style-type: none"> - Power voltage low or missing; check Logger fuse - Check signal, power and ground connection
No level change or level errors	<ul style="list-style-type: none"> - Check encoder output - Level rate of change exceeds receiving device capability - Ensure pulley is tight - Increasing level causes decreasing reading; reverse encoder leads - Check pulley scale set in logger - Check float for binding
Shaft hard to turn	<ul style="list-style-type: none"> - Check encoder support bracket - Check bearings (standalone)

Dynotek Slimline Submersible Pressure Transducer

This type of sensor is lowered into the well on a reinforced cable and submerged below the water. Once in place, the initial water pressure reading is synced with the current water level. The unit then monitors the water pressure for changes, and the pressure difference is converted to a change in water level. The entire unit is hermetically sealed to prevent any moisture from getting into the instruments (Figure 4).



Figure 4. Dynotek Slimline Transducers

Specifications

Power: 9 to 30 V for excitation.

Pressure Range: 30, 50, 100, 200, 350, 500, 700, and 1000 psi sealed gauge (based on gauge pressure 12.7 psi absolute)

Dimensions: Length – 7.1 inches. Outside diameter – 0.69 inches.

Operating Temperature: -5 to +140° F (+15 to +60° C).

Maintenance

TWDB measures the water level manually whenever visiting recorders because pressure sensors have been occasionally known to “drift” away from an accurate measurement. These inaccuracies are hard to see in the data because they occur gradually over time, unlike a hung or bound tape in a shaft/pulley system. If the level is significantly different from the transducer reading, reset the transducer to the new level.

Stevens GS-93 Logger

The Stevens GS-93 logger is a single-input, solid-state data logger with a built-in display and keyboard, real time battery-backed clock, and calendar. Although data are now transmitted via satellite, the logger also has a removable memory card that can store up to 120,000 readings. The built-in display and controls (Figure 5) allow field programming and diagnostics without a laptop or other external device.

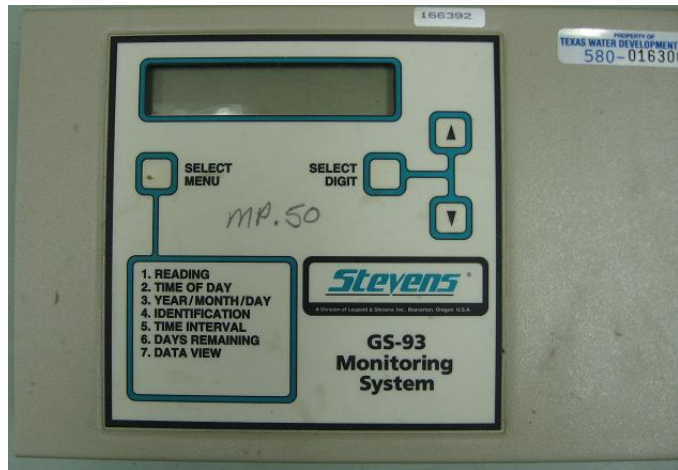


Figure 5. Stevens GS-93 Logger

The logger operates in two modes. In “Data Logger” mode, it receives input from the A/F encoder, converts it into water-level information, and stores the data on the memory card. In “Data Port” mode, data are uploaded to a computer connected directly via the serial port. Once the data are uploaded, the memory card is erased.

Specifications

Serial Channel: Serial ASCII through RS-232 interface at a minimum of +5 volt levels. Provides telemetry of current level when the logger is configured in Data Logger mode. Provides total memory readout of the data card when the logger is in Data Port mode.

Format (fixed): 7 data bits, 1 stop bit, even parity

Power: 10-17 volts of direct current (VDC)

Current: Less than 3.5 mA DC, during normal recording; typically less than 50mA DC when awake for serial transmission. Logger in Data Logger mode enters a low current Sleep mode when no activity is required.

Typical Battery Life: 45 days for 5 amp hour (Ah) lead acid battery

Transformer Supply: For logger in Data Port mode: 120 volts of alternate current (VAC) operation/12VDC (0.2 A) wall plug. The logger in Data Port mode may be powered by a battery, but the logger will not go to “sleep” in this mode.

In-line Fuse: External ¼ A, fast-acting, 3 automobile glass (AG) or equivalent

Real-time Clock: Accuracy +3 minutes per month. Built in leap-year correction.

Display: 8-digit numeric LCD. Integral four-key touchpad.

Input: (A/F shaft encoder): Optical encoding with quadrature output. 400 increments per revolution. For use with 18-inch circumference pulley.

Operating Temperature: -40 to +70° C (-40 to 158° F)

Relative Humidity: 0 – 95%, non-condensing

Size: 11 x 6.5 x 2 inches (28 x 16.5 x 5.1 cm)

Weight: > 3lbs

Operation

The GS-93 Logger features two menus to establish the basic operating mode and to select specific operating conditions. All menu selections are made with the built-in keyboard. The two menus can be toggled by pressing the SELECT MENU and SELECT DIGIT simultaneously.

Keypad/Display Interface

The keypad/display interface is a menu-driven system consisting of seven menu items (Figure 5). The four buttons are: SELECT MENU, SELECT DIGIT, ▲(UP) and ▼(DOWN). The SELECT MENU button allows the user to scroll through the seven selections. The current selection is noted as the left-most digit on the display. The next digit is always blank, and the other six display the value for the given menu selection. The seven menus are:

Setup Menu

1. **Operating Mode** – this toggles between L1 (normal operating mode), L2 (continuous display mode), L3 (data logging with telemetry), L4, (data logging with GOES output, standard reading), L5 (data logging with GOES output, reading and offset), and P1 (data port mode).
2. **Baud Rate** – select a setting from 300, 1200, 2400, 4800, or 9600. Currently TWDB uses a 9600 baud rate.
3. **Pulley size** – select from 12 inch, 0.375 meter, or use SELECT DIGIT and ▲▼ keys to input a custom size.
4. **Telemetry Offset** – value can range from -99.999 to 999.999 meters.

Main Menu

1. **The Level Menu** – shows the current water level in the format XXX.XX, ranging from 0 to 499.99 feet.
2. **The Time Menu** – displays the time in 24-hour format as XX:XX.
3. **The Date Menu** – displays the year/month/day as YY/MM/DD.
4. **The Identification Menu** – indicates the numeric ID of the unit as XXXXXX ranging from 000000 to 999999.
5. **The Time Interval Menu** – shows the interval between sampling events in hours and minutes as HH:MM. Allowable intervals are 0, 1, 5, 6, 10, 15, 30 minutes, and 1, 2, or 4 hours. An interval of 0 indicates recordings at 1 second intervals.
6. **The Days Remaining Menu** – displays the days remaining before the data card fills up as XXXX, based on current sampling interval settings.
7. **The Data View Menu** – displays a loop that cycles through the current level, date, and time. Using the arrow keys in this menu allows viewing of past measurements stored on the data card, starting with the most recent and going back chronologically.

Editing Fields

Menu entries may need to be edited in certain cases. This is done by selecting the desired menu, then using the SELECT DIGIT key to scroll through the digits one at a time from left to right. As a selected digit is flashing, the ▲(UP) and ▼(DOWN) keys can be used to increase or decrease the value. Once the editing is complete, the menu must be exited through the SELECT MENU button for the change to be saved. If this is not done, the edited value will be lost once the logger goes into Sleep mode.

Additional Operations

1. **Battery Voltage** – pressing SELECT MENU + ▼ simultaneously displays a reading of the system battery voltage in the form of XX.X volts.
2. **Firmware Revision** – pressing SELECT MENU + ▲ simultaneously displays the current logger firmware revision level.
3. **Quick Level Reading and Sleep** – pressing ▲+▼ simultaneously during sleep mode to obtain a water level reading. Pressing this combination during normal operating mode will initiate sleep mode.

Serial Port Operation

Unlike the DOT loggers, the GS-93 logger cannot also be accessed through the serial port connection.

Maintenance and Troubleshooting

The GS-93 logger should be safely enclosed in a recorder shelter to ensure a clean, dust-free environment. When visiting a recorder, the following routine maintenance steps should be taken:

- 1) Check the battery. If voltage ever falls below 12.0 V, the battery should be replaced to ensure no loss of data
- 2) Gently rotate the float pulley to check if it turns freely. Clean out any dust or sand that may have settled on the pulley system.
- 3) Check all contacts on the I/O connectors for corrosion, and make sure the enclosure is sealed tight to prevent entry of dust or moisture.
- 4) Do not attempt to open the A/F Encoder housing. There are no serviceable parts inside and you may damage the unit's alignment or introduce dust or moisture.
- 5) Do not force the data card into the logger. If it doesn't go in easily, check to make sure it is aligned properly and that nothing has fallen into the access slot.
- 6) If the keyboard and display get soiled, they may be cleaned with a mild window cleaner or isopropyl alcohol and a clean cloth or tissue.
- 7) When operating in moist environments, check the desiccant in the GS-93 enclosure and replace it when indicated.

Stevens GS-93 Troubleshooting Table

Symptom	Problem or Action
No Display	<ul style="list-style-type: none"> - Power voltage low or missing; check fuse - Check power or ground connections
No level change or level errors	<ul style="list-style-type: none"> - Check encoder/transducer connections - Ensure pulley is tight - If increasing level causes decreasing level, reverse encoder signal leads - Set scale of pulley - Level change exceeds 1.2 ft/sec - Check float for binding
Flashing menu digit persists	<ul style="list-style-type: none"> - Data card not fully inserted - Unit in Data Port (P1) mode - See HLP 03 below - System voltage <10 V
No serial communications	<ul style="list-style-type: none"> - Wrong baud rate - Wrong serial cable - Check cable connections
Display does not go blank	<ul style="list-style-type: none"> - Unit set for continuous display - Serial port active (due to modem or other device) - Flashing menu digit (see above) - Flashing digit indicates incomplete parameter edit; press SELECT MENU

Stevens GS-93 Help Messages (during serial connection)

HLP 01 – The data card is write-protected	<ul style="list-style-type: none"> - Remove data card - Set write-protect switch (on the end of the card) so the card is not write-protected - Re-insert data card
HLP 02 – The data card could not be erased or formatted	<ul style="list-style-type: none"> - Remove card and re-insert several times - If card insertion always produces the message, that card cannot be used
HLP 03 – The card is full of data	<ul style="list-style-type: none"> - Replace with an empty card

Stevens DOT Logger

The Stevens Data Online Telemetry (DOT) Logger is designed specifically for use in cases of remote data sampling via telemetry. A major difference from the GS-93 is that there is no keyboard or display (Figure 6). All commands and readings must be accessed with a computer through the serial port.

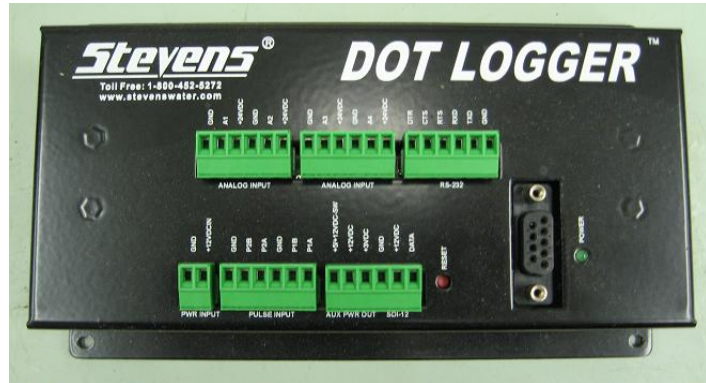


Figure 6. Stevens DOT Logger

Specifications

Inputs: 4 analog, 1 SDI-12

Serial port: Standard RS-232 for communications, setup, and download of data

Format: 8 bits, 1 stop bit, no parity

Power: 0.2 mA from a 12 VDC source in standby. Requires at least 11.5 V for operation.

Operating Temperature: -40 to +160° F (-40 to +70° C)

Serial Port Operation

The DOT Logger is operated through the serial port and requires a separate device such as a laptop for field programming, setup, and download of data through the DOTSet software program. See the DOT Logger Manual for instructions

(http://www.stevenswater.com/catalog/products/data_loggers/manual/dotlogger92963coct2005.pdf).

Maintenance

Always check the battery voltage and condition. Clean any dust or debris off logger and provide protection from moisture and desiccant as needed.

Stevens DOT Logger Troubleshooting Table

Symptom	Problem	Area to Check
No LED	No power to logger	<ul style="list-style-type: none"> - Power supply connections or failure - Voltage level low
Incorrect or continuous minimum reading	Sensor connections; sensor failure	<ul style="list-style-type: none"> - Connections poor or reversed - Wrong sensor or address
No serial communication	Serial port error	<ul style="list-style-type: none"> - Wrong serial cable or poor connections - Baud, bit count, or parity not correct
LED does not blank (sleep)	Sleep mode error	<ul style="list-style-type: none"> - Something is holding push button on - Serial port is active

Sutron SatLink 2 Logger & Transmitter, Model SL2-G312-1

The Sutron SatLink 2 (Figure 7) performs the duties of both logger and transmitter. All programming and setup must be done with an external device such as a laptop connected through the serial port. For operation through Satlink Logger Communicator and SatComm Pocket PC programs, see instruction manual at http://www.sutron.com/downloads/DownloadsUpdates/satlink_2_user_manual.pdf.

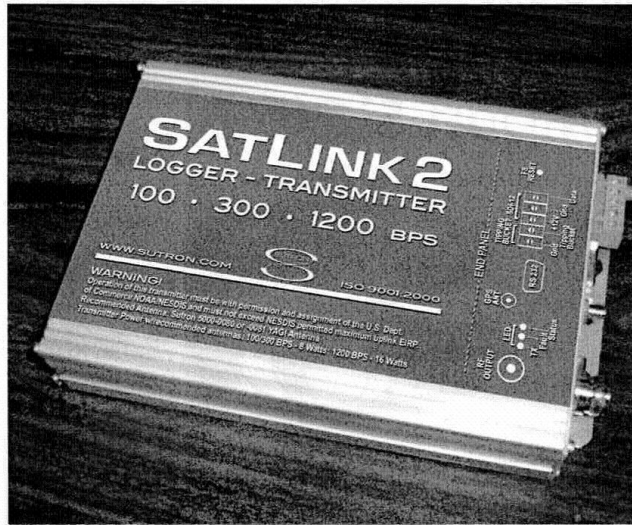


Figure 7. Sutron SatLink 2

Specifications

Power: 10.4 to 15 VDC. Draws 6 mA in sleep mode, 3.8 A at 300 bauds per second (BPS) transmission, 4.8 A at 1200 BPS transmission.

Size: 5.55 x 7.70 x 1.75 in.

Weight: 2.2 lbs.

Operating Temperature: -40 to +60° C (-40 to +140° F)

Clock: Sync to GPS within 10 ms

LED Indicators

- Status
- Fault
- Transmit

Connections

- Power: Built in cable
- GPS: SMA (Bulkhead mounted)
- RS-232: DB9
- SDI-12: 3 position removable terminal strip
- Tipping Bucket: 2 position removable terminal strip

- Analog input: 8 position removable terminal strip
- RF: N-type

Transmission Modes

- 100 BPS random and scheduled
- 300 BPS random and scheduled
- 1200 BPS scheduled
- 4800 BPS INSAT selectable 10 min. window

Sutron SatLink 2 Troubleshooting Table

Symptom	Problem or Action
Logger will not turn on	<ul style="list-style-type: none"> - Check power connections - Check battery charge - Check fuse
LED blinks, but Communicator still cannot find SatLink Logger	<ul style="list-style-type: none"> - Reboot - Check serial port connections - Make sure COMM port is not being used by another program
Sensor not recording data	<ul style="list-style-type: none"> - Press “Refresh Data” on Data tab - Check current configuration - If system is stopped, press Start button - In status display, make sure desired measurements are set as active - Check interval and time set
Logger skips measurements	<ul style="list-style-type: none"> - Interval is too short
Measurements are fine, but not transmitting	<ul style="list-style-type: none"> - Check settings in the Main tab to ensure transmissions are enabled - Check if failsafe has tripped - Check battery voltage during transmission - Make sure station ID is set - Make sure channel is valid - Check RS232 and GPS connections
First transmission after reboot fails	<ul style="list-style-type: none"> - Unit may require up to 30 min to acquire GPS time synchronization in a new area. Transmissions before this occurs will fail.

Stevens GOES HiDataRate Transmitter (GHT)

The Stevens GOES HiDataRate Transmitter (GHT) is a fully compliant 100/300 baud GOES transmitter designed for remote applications. It performs as a satellite modem, collecting data from the data logger for packetization and transmission over the GOES satellite system (Figures 8 & 9).

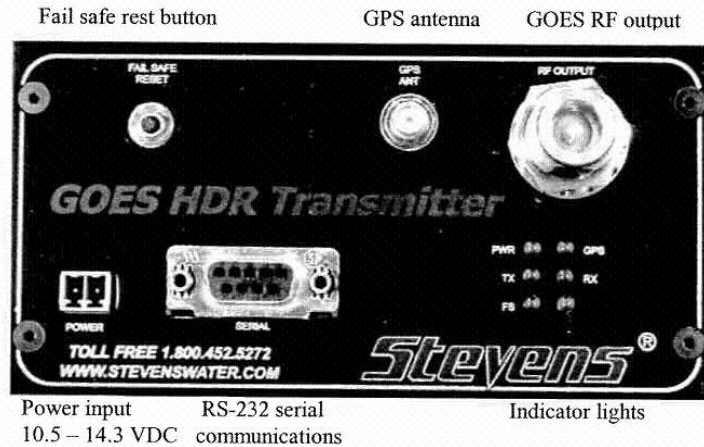


Figure 8. Stevens GHT front panel

The GHT operates like a standard telephone or cable modem. It has a single serial port, operating in two standard modes, command mode and online mode. Command mode is used for setup and programming, online mode is the regular operational mode. The GHT also contains an onboard GPS module for accurate timekeeping.

Operation

The GHT can connect to a computer through the Serial Port Interface. Commands may be entered and data may be transferred through the serial port. Commands are coded with two letters and include the following:

Console Commands

BR – Baud Rate
CO – Console Setup
CT – CTS Time
DX – Expanded Format
EC – Echo Incoming Data Enable
ED – Escape Delay
ES – Console Escape
HE – Help
IC – Init Console
LI – Lines per Page
LL – Line Length
R+ – Random Enter
R- – Random Exit
RO – Random Timeout
RP – Random Repeat
VE – Verbose Enable

Z8 – User Timeout

- 1) **BR (Baud Rate)** – sets the baud rate for communication with a computer or other serial device. The other device must operate at the same baud rate as the GHT for communication.
- 2) **CO (Console Setup)** – displays the current settings of the above listed commands
- 3) **CT (CTS Time)** – sets the time prior to transmission that the GHT will wake up the connected logger for data transfer. Default is 15 seconds. A setting of 0 places GHT in constant “listen” mode.
- 4) **DX (Expanded Format)** – allows selection of TERSE or EXPANDED format for given responses. TERSE format will suppress some messages during activity while EXPANDED includes all messages.
- 5) **EC (Echo Serial Enable)** – toggles echo of commands back to the programming device attached to the GHT (laptop etc).
- 6) **ED (Escape Delay)** – amount of delay in seconds between input of the Console Escape character entries. Default is 3 seconds. See next command.
- 7) **ES (Console Escape)** – selects character “password” code that will interrupt ONLINE mode and switch the unit to COMMAND mode. This code must be input three times, with a delay between each input equal or greater to the Escape Delay (ED) entry. For example, if the ED is 3 seconds and ES code is 1x0B, “1x0B” must be entered three times with a delay of 3 or more seconds between entries.
- 8) **HE (Help)** – displays a summary of all available GHT commands.
- 9) **IC (Initialize Console)** – resets GHT to factory default settings.
- 10) **LI (Lines per Page)** – pauses display after a given number of lines have been received. Setting to 0 causes data to be continuously displayed until completed or interrupted by the ESCAPE key.
- 11) **LL (Line Length)** – sets the length of the output line to match display window. Typical setting is 80 characters per line.
- 12) **R+ (Random Enter)** – sets the character sequence that precedes a random message string. This sequence will not be included in the random message. Default is “++R”
- 13) **R- (Random Exit)** – sets the character sequence that indicates the end of a random message string. This sequence will not be included in the random message. Default is “++E”

- 14) **RO (Random Timeout)** – sets the amount of time allowed for the input of a random message. If the exit character is not encountered by this time limit, the message is terminated at that point. Default is 60 seconds.
- 15) **RP (Random Repeat)** – sets the amount of times a random message will be repeatedly sent.
- 16) **VE (Verbose Enable)** – toggles display of various additional information when a command is executed.
- 17) **Z8 (User Timeout)** – sets the amount of time in seconds of inactivity before the unit automatically returns to ONLINE mode. Default is 300 seconds.

System Commands

BV – Battery Voltage
CE – Clear Error
CM – Command/Control Menu
CP – Change Password
DA – Date
GS – GPS status
GT – GPS Satellites Tracked
LD – Log Dump
MM – Main Menu
OL – Online
PW – Reenter Password
RS – Reset
SC – Save Configuration
SS – System Setup
SV – System Version
TH – Temp & Humidity
TI - Time

- 1) **BV (Battery Voltage)** – verifies voltage of power source connected to GHT.
- 2) **CE (Clear Error)** – resets any fault error codes to 0.
- 3) **CM (Command/Control Menu)** – displays C/C Menu.
- 4) **CP (Change Password)** – changes the system password.
- 5) **DA (Date)** – allows manual date entry. This info is usually downloaded through the GPS link. Info is in UTC/Zulu format.
- 6) **GS (GPS Status)** – forces a manual GPS time update.

- 7) **GT (GPS Satellites Tracked)** – sets minimum number of satellites tracked to confirm a valid time sync. Default is 3.
- 8) **LD (Log Dump)** – dumps the current error log to the screen for diagnosis.
- 9) **MM (Main Menu)** – displays main menu.
- 10) **OL (Online)** – initiates ONLINE mode.
- 11) **PW (Enter Password)** – allows access to various commands. Default is simply pressing enter, password can be changed with CP command.
- 12) **RS (Reset)** – resets GHT to original factory conditions. Use with caution.
- 13) **SC (Save Configuration)** – saves configuration settings. This is done automatically when unit enters ONLINE mode, but settings can be lost if the unit is powered down before that.
- 14) **SS (System Setup)** – displays current system settings.
- 15) **SV (Software Version)** – displays software version for the operational firmware within the GHT.
- 16) **TH (Temperature & Humidity)** – not implemented
- 17) **TI (Time)** – allows for manual entry of time. This info is usually downloaded through the GPS link. Info is in UTC/Zulu format.

Channel Commands

CH – Channel Self-timed
 CS – Channel Setup
 HR – Channel Random
 IR – Interval Random
 IS – Interval Standard
 NX – Next Time
 RB – Radio Baud Rate
 RR – Radio Baud Rate – Random

- 1) **CH (Channel, Self-timed)** – Sets the NESDIS channel number for standard, timed transmissions. Allowable values are 1-266.
- 2) **CS (Channel Setup)** – displays current channel settings, including both timed and random transmission information.

- 3) **HR (Channel, Random)** – sets the NESDIS channel for random transmissions. Allowable values are 1-266.
- 4) **IR (Interval, Random)** – sets the transmit interval for random transmissions. Transmissions will be sent at random times, averaging around the programmed interval, when the unit is online.
- 5) **IS (Interval, Self-timed)** – sets the transmission interval for timed transmissions. Transmissions will be sent at each interval, synchronized by the GPS clock, and offset by the amount indicated in the TO command (under Satellite Commands below). This parameter is specified by NESDIS for each GHT installation.
- 6) **NX (Next Time)** – not implemented
- 7) **RB (Radio Baud Rate, Self-timed)** – sets baud rate for timed messages, either 100 or 300 baud.
- 8) **RR (Radio Baud Rate, Random)** – sets baud rate for random messages, either 100 or 300 baud.

Satellite Commands

GH – GHT Header
 ID – NESDIS ID
 MF – Message Format
 ML – Message Limit
 PB – Pseudo Binary
 QP – Carrier Preamble
 SI – Satellite Information
 TO – Transmit Offset
 VR – Interleave Random
 VS – Interleave Standard
 XR – Transmit Random Enable
 XS – Transmit Standard Enable

- 1) **GH (GHT Header)** – allows user to select certain operational parameters and place them in a data packet at the beginning of every data transmission. If the message is in pseudo-binary format, a packet header number between 0 and 63 must be specified.
- 2) **ID (NESDIS ID)** – sets NESDIS ID. ID must be obtained from NESDIS and entered into GHT before transmissions can be received or processed.

- 3) **MF (Message Format)** – selects format for either random or timed messages. Select between ASCII and Pseudo-binary formats. Invalid characters are replaced with “/” in either case.
- 4) **ML (Message Limit)** – sets the maximum size (in bytes) of a message, or the message window. Timed messages can be up to 3600 bytes, or 120 seconds at 300 baud. Random messages can be up to 64 bytes, or about 2 seconds at 300 baud. Any value smaller than these can be entered. Excess information beyond the limit will be truncated.
- 5) **PB (Pseudo-binary)** – not implemented
- 6) **QP (Character Preamble)** – choose between short or long preamble.
- 7) **SI (Satellite Information)** – displays various satellite configuration parameters.
- 8) **TO (Transmit Offset)** – sets the offset time from UTC midnight for the first transmission of a given day. Specified by NESDIS along with transmit interval.
- 9) **VR (Interleave, Random)** – Inter leavers can be selected to provide additional error correction encoding, primarily for burst errors.
- 10) **VS (Interleave, Standard)** – Inter leavers can be selected to provide additional error correction encoding, primarily for burst errors.
- 11) **XR (Random Transmit Enable)** – toggles random transmissions on and off. If not enabled, random messages received from the data logger will be ignored.
- 12) **XS (Standard Transmit Enable)** – toggles standard, timed transmissions on and off. If not enabled, standard messages received from the data logger are ignored.

Maintenance and Troubleshooting

Upon each visit, check to ensure the battery is producing at least 12 V, and that the enclosure has an adequate desiccant.

Stevens GHT Troubleshooting Table

Symptom	Problem	Area to Check
No power LED indication	No power to GHT	<ul style="list-style-type: none"> - Power supply connections or failure - Voltage level low
No transmissions	Antenna failure or programming error	<ul style="list-style-type: none"> - Antenna connections - NESDIS ID, interval, channel, transmit offset
No serial communication	Serial port error	<ul style="list-style-type: none"> - Wrong serial cable or poor connections - Baud, bit count, or parity not correct
Failsafe LED on or flashing	Failsafe error	<ul style="list-style-type: none"> - Messages are too long or too frequent - Press FS Reset to clear



Figure 9. Stevens GHT connected in the field

Antennas

TWDB recorders can use several different types of antennas (Figure 10), but all operate in a similar manner. They are mounted on a pole or on top of the shelter itself, connected to the transmitter inside the shelter, and pointed at the GOES satellite. Primary maintenance includes keeping the mount secure, checking the connections, removing any obstructions that may block the transmission, and checking the orientation of the antenna.



Figure 10. A few antenna types used on TWDB recorders

Antenna Orientation

Two values describe the position of the antenna. Elevation refers to the angle of the antenna to the horizon. A low elevation would be pointing almost horizontal, while a high value would indicate pointing almost straight up. Azimuth angle refers to the angle between the antenna's direction and true north. An Azimuth angle of 0° would be due north, 90° due west, and so on. The values needed for a particular recorder site can be looked up on NASA's website, at http://aeronet.gsfc.nasa.gov/new_web/antenna.html (Figure 11). After inputting the satellite (always GOES West for Texas) and the latitude and longitude in decimal degrees format, the necessary angles are given (Figure 12).

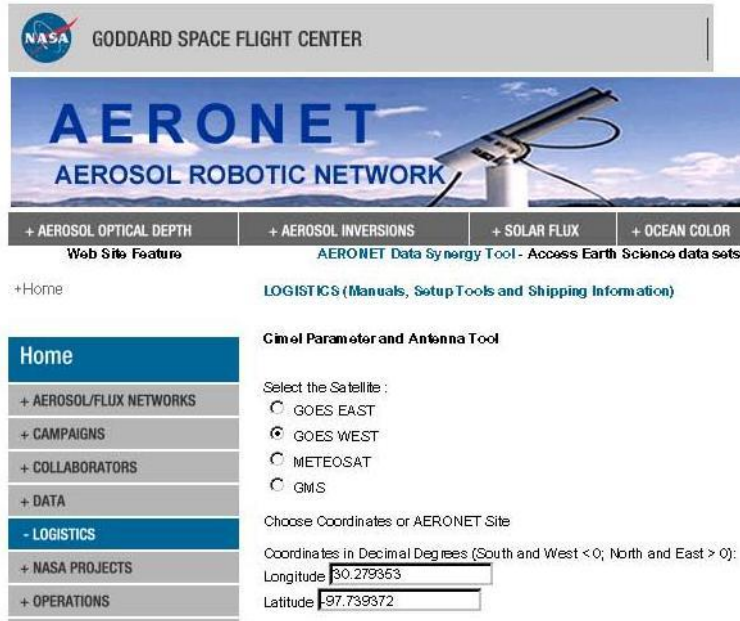


Figure 11. Input GOES West and lat/long values into NASA's website for antenna angles.
http://aeronet.gsfc.nasa.gov/new_web/antenna.html

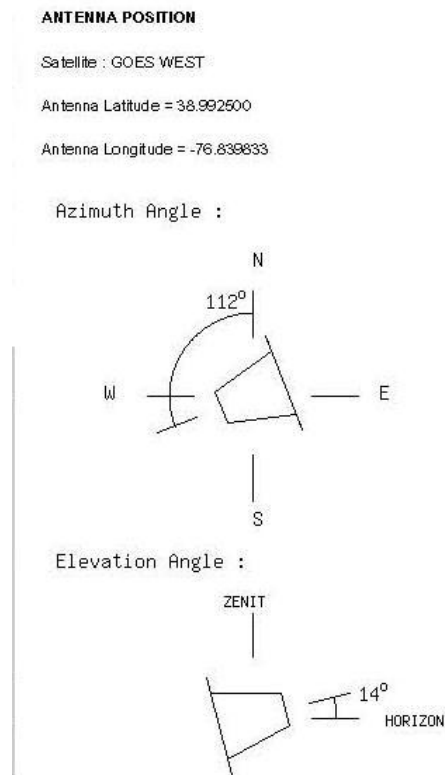


Figure 12. The angles are given with positioning diagrams