8310 & 7310 Dataloggers

Operations & Maintenance Manual

Part No. 8800-1185 Rev. 2.12
June 27, 2017

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Using This Manual

This manual describes the operation and maintenance of the Sutron 8310 & 7310 family of data recorders/transmitters. It is designed to be of use to both beginning and experienced users. Reference in the manual to the 8310 are also referring to the 7310, with the exceptions of those feature not included on the 7310 platform (see 7310 Features)

There are twelve chapters in this manual. These twelve chapters introduce you to the 8310 and present the basics to get you started using the 8310. Chapters 1 through 3 should be read by anyone planning to use the 8310. Chapter 4 contains a detailed reference of all the 8310 menus and commands. You should not try to read this chapter from start to finish -- it is intended as a reference. The remaining chapters teach you how to use the 8310 covering topics such as connecting sensors, common setups, installation, retrieving data and others. These chapters have many practical examples of using the 8310 in the field. Of particular note is Chapter 7 which contains many examples on how to use the 8310 in particular situations.

The chapters are presented in the following order:

1. Introduction
2. Unpacking and Initialization
3. Getting to know the 8310
4. Menu Tree Reference
5. Quick Setup
6. Connecting sensors
7. How To...
8. Installation
9. Retrieving Your Data
10. BASIC
11. Maintenance and Service
12. Troubleshooting

Specifications for the 8310 are contained in Appendix A. Other Appendices contain reference information.

Chapter 1: Introduction

This chapter introduces you to the Sutron Model 8310 & 7310 family of data recorders and transmitters and presents the features and capabilities that make the 8310 & 7310 the ideal product to use for a remote environmental monitoring system.

8310 & 7310 Overview

The Sutron 8310 & 7310 are specifically designed to meet the wide variety of remote data collection needs of the hydrologic and meteorological communities. These needs may range from simple data recording to transmission via satellite or other telemetry links.

Each unit has a range of inputs designed to support the most common data collection applications. These include:

- Water Level
- Rainfall
- Temperature/pressure
- Relative Humidity
- Wind speed and direction

The overall 8310 design utilizes low-power circuitry to achieve long-life battery operation and provide a rugged system for unattended field operation in extreme environments. For even more durability, each 8310 is tested to operate over the -40°C to +60°C temperature extremes expected in remote environments. Full EMI and transient protection are built into each input.

8310 Features

The 8310 has the following capabilities and features built-in:

- Simple Front panel setup without PC or other devices.
- Terminal interface for setup using PC without custom software.
- Built-in measurement circuitry to handle sensors commonly used.
- Flexible measurement schedules and logging schemes.
- Built-in BASIC to support custom measurements, processing and communications.
- Built-in support for GOES, Iridium, GPRS, and telephone modems with both data and speech capabilities.
- Dual communications support allowing combinations of supported communications devices.
- Ethernet port with support for scheduled on/off, transmissions, web server, and telnet access.
- Remote operation without using custom PC programs.
- Weatherproof packaging to promote long product life in the field.
- Wide temperature operation to operate reliably in environmental extremes.
- Battery operation with low power consumption.
- Built-in solar panel regulator.

The 8310 can accommodate optional telemetry modules.

- Telephone modem with speech,
- GOES/METOSAT/INSAT Satellite transmitter,
- IRIDIUM transceiver
- GSM/GPRS modem

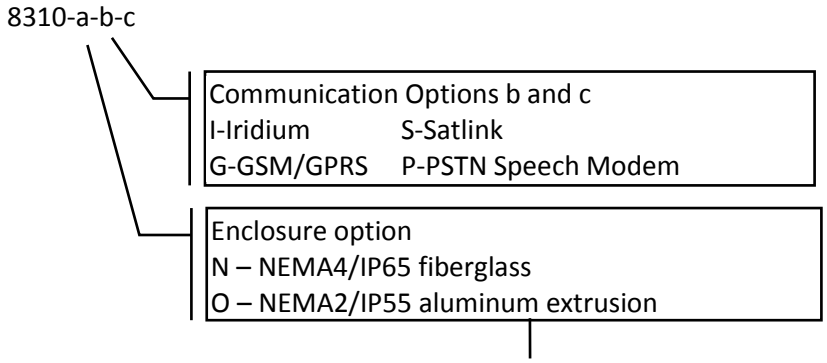
7310 Features

The 7310 runs the same software as the 8310, but has a subset of the features of the 8310. It includes all the features of the 8310 with these exceptions:

- Only one serial telemetry device, com 2
- Only one setup serial port, com 1, no power options on pin 9
- No USB port
- No LAN port
- No RS485 port
- No I^2C expansion port

Model Numbers

The full model number specifies the type ordered as well as the telemetry options selected. The general format of the model number is:



The following are some examples of models that can be ordered:

Part Number	Description
8310-N	8310, NEMA4
8310-O	8310, NEMA2
8310-N-S	8310, NEMA4, with Satlink*
8310-N-S-G	8310, NEMA4, with Satlink* and GSM/GPRS Modem*
8310-N-S-I	8310, NEMA4, with Satlink* and Iridium SBD transceiver*
8310-N-S-P	8310, NEMA4, with Satlink* and Telephone modem (voice and data)
8310-O-I	8310, NEMA2, with Iridium
8310-O-G	8310, NEMA2, with GSM/GPRS
7310-O	7310, NEMA 2

*Antenna and cable ordered separately

Wide Range of Applications

The 8310 may be used to collect basic information from sensors to support a variety of different systems. Typical applications may include:

- Flood Warning
- Weather Stations
- General stage and precipitation networks
- Dam safety monitoring
- On-site recording of many kinds of digital or analog data
- Irrigation control

Inputs Specifically Designed for HYDROMET Applications

The 8310 family was designed from the ground up for the low cost acquisition of data from a wide assortment of sensors. By limiting the number of inputs and by specifically tailoring the design towards measurement of precipitation, wind speed/direction, and water level, Sutron has provided an economical way to obtain needed information.

Simple Setup

The 8310 is based on a powerful microprocessor, allowing users to set up the 8310 in any one of several easy ways:

Front Panel -- setup information can be entered using the 6 keys built into the front panel. The keypad is used to select or modify items in a variety of setup menus.

SD card -- setups can be stored on the SD Memory Cards. To copy a setup to the 8310 simply, plug the SD card into the memory slot and issue the copy setup command. It takes only a few seconds for the 8310 to copy the setup from the card to its memory.

Portable PC -- Those users with access to a portable PC may find it easier to set up the 8310 through the unit's USB or serial port by using standard commercial communications packages (such as HyperTerminal).

Remote PC -- 8310s with telephone modems can be set up remotely by means of a computer terminal or PC.

Easy Wiring

To further ease the process of setup, the 8310s were designed to be easy to hook up in the field. All connections are made through a terminal strip. For the 8310-O, the terminal strip is on the front panel. For the 8310-N, the terminal strip is on the side panel. When all wiring is complete, the entire terminal strip can be unplugged. This feature greatly simplifies unit swapping should the occasion arise.

Sealed Enclosure

Both model 8310s are sealed; however they should not be installed outdoors without additional protection against rain/weather.

Large Secure Memory

The 8310 has built-in flash memory capable of storing the station setup and configuration data along with memory to "log" (or record) over 1,000,000 data points. This memory doesn't use a battery and, as a result, it is always preserved even when power is lost or interrupted to the 8310. This memory can also be expanded using common SD memory cards.

Easily Networked

The 8310s were designed from the start to work closely with other data collection equipment and systems. The built-in Ethernet port allows the 8310 to communicate using TCP/IP, UDP, HTTP, MODBUS TCP, and other Internet protocols. The 8310 supports Sutron Standard Protocol, allowing them to exchange data with other Sutron stations and systems. SATLINK, IRIDIUM and GPRS equipped stations can provide data to a variety of systems including SUTRONWIN and other systems that use Sutron's TEMPEST software.

Chapter 2: Unpacking and Initialization

This chapter provides information to help you unpack the 8310 and start using it. You will learn how to hook a battery to an 8310 and how to run a quick test to make sure it is operating properly.

Unpacking

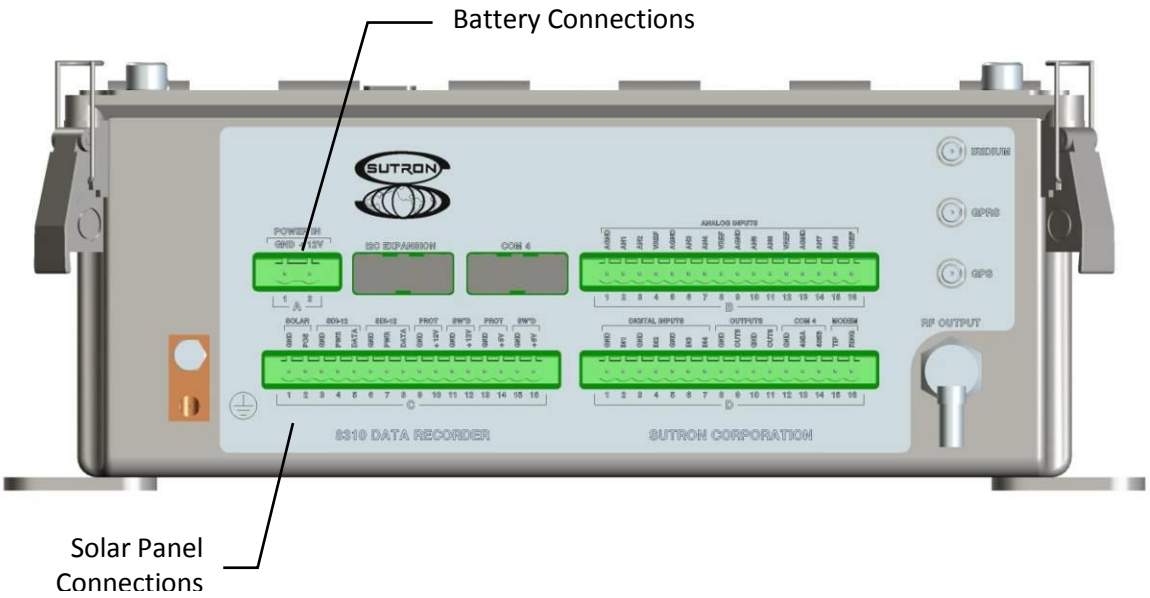
- Carefully remove the 8310 from the shipping container.
- Save the container and packing materials as they may be used to transport the 8310 to the site or for shipping the unit back to the factory.

Note: If you want to return a unit to the factory, first fill out the Product Return Sheet located at the back of this manual and then call the factory (703-406-2800) for an RMA number. This procedure will help us to handle your equipment in the most efficient manner.

Connecting the Main Battery

The 8310 runs off 9 to 18VDC with a peak power requirement of 1 amp (not provided). Connect a suitable power source to the 8310 as shown below. When power is applied, the unit will automatically startup and if configured, begin operations. The startup process takes about a minute. When power is applied, the unit will first play some tones and display the message "Sutron Data Recorder, Please Wait…" The display will then turn off and on again several times as the unit starts. The unit is ready to operate when the "System Startup" message is displayed. This message is only di

splayed for a few seconds before the display is turned off in order to conserve power.



Connecting the Charging Voltage

The next step is to connect a charging voltage to the 8310. Without a charging voltage, the 8310 will run using the power from the main battery. When the battery voltage drops, the 8310 may stop operating until it is charged again. The 8310 can accommodate a charging voltage up to 22 volts that is common from a solar panel. A DC power supply could also be used as the charging

input. If using a DC supply as the charging source, a 15V supply is recommended. On the 8310, connect the charging voltage to the two pins labeled SOLAR GND (C1) and POS (C2). This voltage passes through an internal temperature compensated regulator that keeps a sealed 12V lead acid battery fully charged. The internal regulator is designed to handle up to a 20W solar panel.

Note: The 8310 is designed to always run with a battery connected. It may not run properly if you try to operate it from the solar panel input alone if the system load exceeds the regulator's output capability as would happen when transmitting.

Quick Test

The 8310 is running whenever the battery is connected. To verify that the 8310 is running, press a key on the front panel. The 8310 display should light up and display the station name, date and time. If not, check your connections. Depending on how your particular unit has been set up, the display may remain on, or turn off after a brief period.

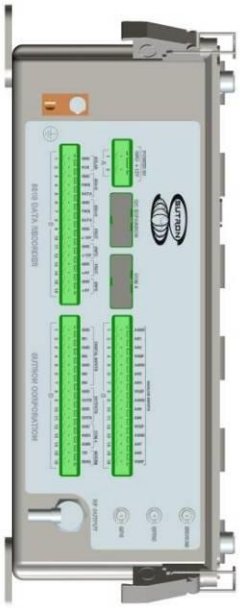
You can also tell the 8310 is running by watching the Status LED. In normal operations, the green LED will flash periodically as the 8310 operates. If the green LED is not flashing or if the red LED is on, the 8310 may not be operating properly.

Chapter 3:
Getting To Know The 8310

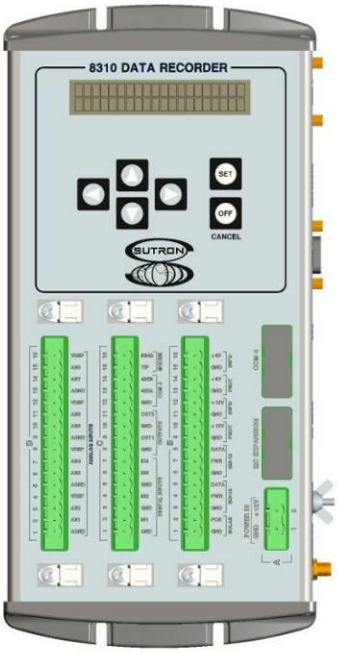
This chapter describes in detail the 8310 front panel (including connections, controls and displays) and the menus that you will use to set up and operate the 8310. Complete information is given on how to operate the 8310 from the front panel or a PC.

8310-N


8310 DATA RECORDER
SET
OFF
CANCEL
SUTRON



8310-O


8310 DATA RECORDER
SET
OFF
CANCEL
SUTRON

7310-O

The Display

The 2 line LCD backlit display is a window into the 8310 system. It is in this area that the 8310 displays a variety of messages which are used to set up and test the unit. The display is ON generally only after pressing a key in the keypad.

The two-line display shows one menu item at a time, using the second line to display additional information like a value, a hint or help. Users can fully setup the logger using this front panel interface (except for Basic). The system includes many features that help simplify the use of the front panel:

The 6-button Keypad

The 6-button keypad (▶ ◀ ▲ ▼ OFF SET) is used to control the 8310.

- Press any key to turn on the display.
- Navigate through menus using arrow keys.
- Press RIGHT to enter a sub-menu
- Press LEFT or Cancel to exit a sub menu.
- "Hints" flash on the bottom line if you pause.
- Text that is too long to fit on the display will scroll
- Press SET to initiate an action or change to a value and then use the arrow keys as needed.
- Press OFF/Cancel to cancel an operation. Repeated presses will turn off the display.

Status and Charging LED

The Status and Charging LED (light emitting diode) are located on the front panel of the 8310-N and on the left side of the 8310-O. The Status LED consists of two LED – one green and the other red. The green LED will flash periodically to indicate activity by the system. The red LED only lights when there are errors present that should be viewed and cleared by the user.

The Charging LED is green when the built-in solar panel regulator is charging the battery. The LED will be off if the voltage from the solar panel is less than the battery voltage.

Terminal Strips

Terminal strips are used to connect sensors, power, and some communication to the 8310. There are two basic configurations for terminal strips depending on the model ordered:

8310-N --The terminal strips are built in to the side of the fiberglass enclosure.
8310-O -- The terminal strips are built into the front of the unit.

Connections to the terminal strip are made as follows:

- Strip approximately 1/8th inch of insulation from the end of a signal or ground wire
- Loosen the appropriate terminal block screw
- Insert the stripped portion of the wire into the small, rectangular opening immediately beneath the screw
- Re-tighten the screw.

After all connections are made to an 8310, the connectors may be unplugged from the unit with all wiring intact. To remove a connector, grasp each end firmly and pull/wiggle until it comes free. The removable connectors make it possible to completely replace an 8310 in a matter of minutes.

Each terminal strip is labeled with a letter, A, B, C and D. The following sections give details on the different connections:

A – Power

Label			Description
A1	POWER IN	GND	GND Battery Connection
A2		+12V	12V Battery Connection

B – Analog Inputs

Label			Description
B1	Analog Inputs	AGND	Analog Ground
B2		AN1	Input channel 1 (1-)
B3		AN2	Input channel 2 (1+)
B4		VREF	2.5V Reference voltage
B5		AGND	Analog Ground
B6		AN3	Input channel 3 (3-)
B7		AN4	Input channel 4 (3+)
B8		VREF	2.5V Reference voltage
B9		AGND	Analog Ground
B10		AN5	Input channel 5 (5-)
B11		AN6	Input channel 6 (5+)
B12		VREF	2.5V Reference voltage
B13		AGND	Analog Ground
B14		AN7	Input channel 7 (7-)
B15		AN8	Input channel 8 (7+)
B16		VREF	2.5V Reference voltage

C – Solar, SDI-12, PROT 12, SW'D 12, PROT 5, SW'D 5

Label			Description
C1	SOLAR	GND	
C2		POS	Solar panel or 15VDC input
C3	SDI-12	GND	
C4		PWR	
C5		DATA	
C6	SDI-12	GND	
C7		PWR	
C8		DATA	
C9	PROT	GND	

C10		+12V	Protected 12 (protected with self-resetting fuse, 900 mA max)
C11	SW'D	GND	
C12		+12V	Switched 12 (battery / protected with self-resetting fuse, 900 mA max
C13	PROT	GND	
C14		+5V	Protected 5V (system voltage with self resetting fuse, 300mA max)
C15	SWD	GND	
C16		+5V	Switched 5V (system voltage protected with self-resetting fuse an solid state switch, 500 mA max)

D – Digital Inputs, Outputs, COM4, Modem

Label			Description
D1	Digital Inputs	GND	
D2		IN1	
D3		GND	
D4		IN2	
D5		GND	
D6		IN3	
D7		IN4	
D8	Outputs	GND	
D9		OUT5	
D10		GND	
D11		OUT6	
D12	COM4	GND	
D13		COM4 RS485A	Idles High (Standard RS-485 nomenclature this would be B)
D14		COM4 RS485B	Idles Low (Standard RS-485 nomenclature this would be A)
D15	Modem	TIP	
D16		RING	

Note: The 8310 provides a very weak bias to maintain the RS-485 idle condition. If the connecting device is expecting stronger bus biasing, then external biasing resistors can be added: one resistor between the D14 (RS485B) and GND terminals with a second resistor between D13 (RS485A) and PROT +5V terminals. For mild biasing, use 100K resistors. For much stronger biasing, use 10K resistors.

SD Card Socket

The SD card socket is located on the front panel of the 8310-N and the left side of the 8310-O. An LED next to the SD card indicates lights when the SD card is being read or written to.

8310s can store either data or setups on industry standard SD memory cards, having a capacity up to 2GB. To transfer data from the 8310's internal memory to the SD Card, or to transfer a pre-programmed set-up from an SD Card to the 8310, insert the card into the SD Card slot and use the SD Card Operations menu. It is possible to store the data from multiple sites on a single card, as space permits.

Further instructions on the use of SD Cards may be found in the SD Card Operations section of Chapter 4, as well in the SD Card section of Chapter 9.

USB/COM1 Serial I/O Port

The most common use of the USB and the COM1 serial port is for a connection to a portable PC. When using a PC, it is possible to see the full setup menus since the computer screen can display an entire menu at one time. The USB/COM1 ports also support transfers and rapid transfers of setups and data to and from the 8310. A PC can simplify any setup or maintenance task. The default baud rate for COM1 is 115,200 baud. The USB port functions as virtual serial interface connection for a PC without an actual serial port and replaces COM1 when connected. When using the USB port, you will need the required virtual com port drivers on your PC. If the PC does not automatically install the appropriate drivers, the appropriate drivers can be downloaded from http://www.ftdichip.com/Drivers/VCP.htm. Once the drivers are installed, then connecting to the USB port will add a new comport to the PC.

Ethernet

The Ethernet connection is located on the front panel of the 8310-N, and on the left side of the 8310-O. Optionally, the Ethernet connection can also be made to the processor board inside the 8310.

To configure the 8310 for operation on a LAN, navigate to the Station Setup/Communications/LAN device menu. There you'll turn the Ethernet port on, and specify how the unit should get an IP address (either via DHCP or by a static assignment). You can also configure the LAN to turn on periodically, and even transmit selftimed and alarm messages over the LAN. See the LAN section in Chapter 4 for more information.

Special Tip: Once the LAN is configured, you can use Telnet to access the 8310 command line and/or terminal menu, as if you were connected by serial cable, but much faster. The 8310 uses the standard port 23 for telnet.

Ground Lug

A ground lug is provided on each 8310 in order to connect the 8310 to an EARTH ground at the site. On the 8310-N, this ground lug is on the side of the enclosure. On the 8310-O, the ground lug is on the protection/termination board. Normally, you should run a 16 gauge wire (or heavier) from this lug to the site ground rod. The length of the wire should be minimized. Failure to do so can render the site more susceptible to damage by lightning.

Front Panel Control of the 8310

Now that you have a working knowledge of the components of the front panel display, it is time to learn about the 8310's inner workings. As mentioned earlier, the 8310 may be set up by means of the front panel buttons or a PC equipped with appropriate software. Even though the 8310 can be set up without using the front panel, it is important to know how to operate it in this way.

Turning the display unit on and off

Press any key to turn on the front panel display. If the display is turned on and left on with no input/output activity it will turn itself off after 60 seconds (the timeout period is settable). This timeout feature conserves battery power. To turn off the display, press the OFF key. Since OFF is also used as a CANCEL key, pressing OFF may not turn off the display immediately. Before the system turns off the display it may display important error or status information.

Hint: Carefully review what is displayed when OFF is pressed and take appropriate action so you do not leave the 8310 configured incorrectly.

Changing the Contrast

The contrast of the display can be adjusted by holding the OFF/CANCEL down and then pressing the RIGHT (increase contrast) and LEFT (decrease contrast).

The 8310 Menu Tree

The display area can be thought of as being a "window" into the menu tree. Moving this "window" up and down the menu tree allows the user to see, and control one level setting at a time. The entire menu tree contains all of the items available to set up and control the 8310. Not all the items are needed each time the 8310 is set up. In this chapter, we will teach you how to move around through the various menus using the arrow keys. You do not need to be concerned with the meaning of all the items in the menu. The complete description of every menu item is explained in Chapter 4.

The menu tree for the standard 8310 is shown on the following pages. Use it as a reference guide when operating the 8310.

The 8310 Menu Tree – Top Two Levels

[Errors Present]
Station name Date/Time
Recording is ON | OFF | ON+TX
Alarm Status: NORMAL | ALARM
Sending Alarm Txs: device | DISABLED
Mx.Ox name value > view log
…
Logged Data >
Select Log
Date/time name value
Station Setup >
Measurements (n) >
Communications (n) >
Logs (n) >
LogRecords (n) >
SNTP (time-sync) >
Users (n) >
Advanced Settings >
Import setup
Export setup
Clear Setup
SD Card Operations >
Download log to card
Write setup to card
Read setup from card
Write basic to card
Read basic from card
Format SD card
End SD Card Operations
Terminal Operations >
Download log
Send Basic to 8310
Get Basic from 8310
Send setup to 8310
Get setup from 8310
Get formatted setup
Upgrade Firmware
End Terminal Operations
Diagnostics >
Communications (n) >
Inputs (n) >
Outputs (n) >
I/O Modules (n) >
SDI Tools >
System Status >
Basic Status: RUN
Clear Cal Data
Debug to System Log
Upgrade Firmware
Exit 8310 application
End Main

Notes:

The ">" indicates the presence of a sub menu.

The 8310 Menu Tree – All Levels

[Errors Present]
Station name Date/Time
Recording is ON | OFF | ON+TX
Alarm Status: NORMAL | ALARM
Mx.Ox name value > view log
…
Logged Data >
  Select Log
    Date/time name value
Station Setup >
  Measurements (n) >
    Mx: name > status
      MeasName name
      Enable YES | No
      MeasType
      [MeasType values]
      InputType
      [InputType values]
      SwitchedPwr
      [SwitchedPwr values]
      Processing
      [ProcessingType values]
      Cal Slope
      Cal Offset
      Mx:Ix: Cur Val
      Mx.Ox: name > value
        Name
        Units
        RightDigits
        Processing
        [Processing values]
        Display
        Log
        LoggingInterval
        RecordID
        Add Alarm
        IsSSPCurData
        LAN
        Voice COMx:
          TxAlarmMode
          PrefixPhrase
          SuffixPhrase
        Satlink COMx > SelfTimed Setting
          Content
          [Time]
          [Interval]
          [NumberVals]
          Sequence
        Satlink COMx > Random settings
          MemberGroup2
          MemberGroup3
          …
          Sequence
          NumVals
          GroupTrigger
    Mx: name > status

…
Add Measurement
Delete Measurement
Copy Measurement
Move Measurement

Station Setup >
Basic

Station Setup >
Communications (n) >
Comx: (state) DIRECT | Radio | SSP | RS485
Enabled
BaudRate
MasterID
TXNormalRate
TXAlarmRate
SSP Settings > details
CarrierDelay
ReplyDelay
AckDelay
NumRetries
RetryDelay
Comx: (state) SATLINK
SatID
InitSatlink
LocalTimeOffset
SelfTimedSettings >
Enabled
Time
Interval
Channel
CenterWindow
WindowLength
Type
Format
AppendLatLon
AppendQuality
Select outputs >
***
RandomSettings >
Enabled
NormalRate
AlarmRate
BurstRate
NumAttempts
Channel
Type
Format
NumVals
AppendLatLon
AppendQuality
Select outputs >
***
Comx: (state) VOICE
Enabled
BaudRate
MasterID
AnswerMode
RingToAnswer
Language
PhoneNumber1

...
PhoneNumber10
RedialDelay
NumRedials
DialInMsg
DialOutMsg
SSP Settings
CarrierDelay
ReplyDelay
AckDelay
NumRetries
RetryDelay

Station Setup >
Communications (n) >
Comx: (state) MODEM
Enabled
BaudRate
MasterID
AnswerMode
RingToAnswer
PhoneNumber1
...
PhoneNumber10
RedialDelay
NumRedials
SSP Settings
CarrierDelay
ReplyDelay
AckDelay
NumRetries
RetryDelay

Station Setup >
Communications (n) >
Comx: (state) MODBUS
Slave
DeviceID
BaudRate
Parity
Protocol
RTSPreDataMS
RTSPostDataMS
WaitForDSR
WaitForCTS
RS485

Station Setup >
Communications (n) >
ModbusTCP
Enable
Port
EnableLAN

Station Setup >
Communications (n) >
LAN
Power
Enabled
MasterID
TxInterval
TxTime
AlarmData
PrimaryIP
SecondaryIP

MessagePort
ServerPassword
UseDHCP
Select Outputs

Station Setup >
Logs (n) >
Data.log > details
Log Size:
Wrap log when full?
Ignore bad data?
Value for bad data:
Header on export?
Add note to log
System.log > details
same fields as above
Add Log
Edit Name
Enter Size
Delete Log
Select Log

Station Setup >
Users (n) >
User name
Password
User group
Timeout
Allow Command Line
Allow SSP
Allow TCP/IP
Allow UI
Station Setup >
Advanced Settings >
FixedInternalPorts
Display timeout (s)
Flash Duration (s)
Terminal Text Color
Terminal Bkgnd Color
Import setup
Export setup
Clear Setup
SD Card Operations >
Download log to card
Write setup to card
Read setup from card
Write basic to card
Read basic from card
Format SD card
End SD Card Operations
Terminal Operations >
Download log
Send Basic to 8310
Get Basic from 8310
Send setup to 8310
Get setup from 8310
Get formatted setup
Upgrade Firmware
End Terminal Operations
Diagnostics >

Communications (n) >
COMx: (state)
Tests and info
…
LAN (state)
Power
Users
Config >
Next task
Next task time
SelfTimed Status >
Last Tx
#Tx today
Next Tx time
Next Tx msg
Next Tx size
Est #Tx bytes/day
#Tx bytes today
Alarm Status >
Last Tx
#Tx today
#Tx bytes today
Power Status >
Status
Last pwr-on
Next pwr-on
Last pwr-off
Next pwr-off
LAN Status >
Status
#Tx bytes today
#Rx bytes today
#Tx/Rx errors
Total connect time
Send text tx
Send SSP mail
Last SSP mail rx >
No mail
Reset Com Device
Inputs (n) >
MxIx: Calibrate
MxIx: I/O Config
MxIx: Raw Val
Outputs (n) >
Mx.Ox: name value >
Jump to setup of Mx.Ox
…
I/O Modules (n) >
(ModuleName)
Serial Number
Address
Module Number
Type String
…
Reset module bus
SDI Tools >
Find SDI devices

Show found (0) SDI
Send SDI-12 command
System Status >
Recent Messages
8310 vX.Y.Z
Communications
Basic Status
i2c Statistics
Serial Number
Num Resets
CPLD Version
Basic Status: RUN
Selftest
Clear Cal Data
Debug to System Log
Upgrade Firmware
Exit 8310 application
End Main

Positioning within the menu tree

Positioning within the menu tree is controlled by the 4 arrow keys. Pressing the ▼ (down arrow) key causes the display window to move one step down in the menu. Similarly the ▲ (up arrow) key causes the display window to move up within a menu. The ► (right arrow) key is used to "move into" a sub-menu. For example, when the display window has been moved down the main menu until Logged Data is shown, pressing ► will shift the display to show Select Log (the first item of the Logged Data sub menu). If the menu item has no sub-menu, pressing ► will have no effect. The ◄ key moves you left or up one menu level each time it is pressed. If you are in a sub-menu, pressing ◄ will return you to the previous higher menu level. No matter where you are in the menu tree you can return to the top of the main menu by pressing ◄ repeatedly.

Special Tip: the second line of the display will flash a hint describing what will happen when RIGHT or SET is pressed. Look for the hint to help you operate the 8310.

Special Tip: If you hold one of the arrows down for more than a half second, it will automatically repeat.

Now that you can navigate through the menus, let us introduce a few terms or conventions we have adopted to help describe the 8310 menus.

MAIN MENU -- We will use the term *main menu* to describe all those items that appear by pressing only the down arrow from the top of the tree. These items are UnitID, Date, Time, Recording, Alarm status, Sending Alarm Txs, Logged Data, Station Setup and so forth. (When using a PC, all these items appear in a single menu which makes the concept of a MAIN MENU clearer.

MENU, SUBMENU -- There are also other *menus* and *submenus* in the 8310. Like the *main menu*, they contain all the items that appear by pressing only the down arrow. The Station Setup menu has the items Measurements, Communications, Logs, LAN settings, etc.

FIELD -- We will use the term *field* to describe any item in the menus that accepts a value. You will always see the value displayed next to the name of the *field*. *Time* is a *field* (which holds the value of the time) as is Recording and many others. You set the 8310 by changing the values of the *fields*.

FUNCTION -- Some items in a menu look like *fields* but do not have a value displayed. These are *functions* that cause the 8310 to do something. An example of a *function* is *Station Setup*/*Import Setup* that causes the 8310 to read in a new setup file.

MENU PATH -- A final convention that we have developed is what we call the ***menu path***. The menu path is a concise way of explaining the menus and sub menus used to go to a specific

item. You read the menu path from left to right and MAIN MENU is implied in the path. For example

MENU PATH=Station Setup/Measurements/M1/

tells you to select Station Setup from the MAIN MENU (main menu is implied) and then Measurements (from the Station Setup menu) and then M1 (measurement 1).

Changing Values and Executing Functions

Functions are executed and fields are changed by means of the SET key and the arrow keys. The following paragraphs illustrate how these keys are used to set the *Station Name*, *Date*, *Time*, and *Recording*. Similar keystrokes are used to change any field in any menu tree.

Setting the Station Name

The *Station Name* is the top entry in the main menu displayed along with the date and time (e.g. "Station RiverFork, 10/22/2010 14:23:04". To change the *Station Name,* use the arrow keys to navigate to the Station Name. Note that the hint "SET change name/time" will appear. Press the SET key to start the change. A flashing cursor will appear at the first character of the *Station Name*. To change the first character, press the up or down arrow keys. Each depression will cause the displayed character to change. Numbers from 1 through 10 and letters from A through Z are available. When you have the desired selection displayed, press the ► right arrow key to move to the next character. Repeat this process until the *Station Name* is correct. (You can move backwards in the *ID* by pressing the ◄ left arrow key.

> Special Tip: to clear the entire ID all at once, press the ◄ left arrow key until it reaches the far left. With the next press the message "Clear string?, SET=YES, CANCEL=NO" will be displayed. Press SET will then clear the string and CANCEL will leave it in tact.

When you have entered the *Station Name* you desire, press SET to make it permanent. The flashing cursor will disappear and your selection will be saved. If you wish to cancel your change of the *Station Name,* press OFF instead of SET. This causes the 8310 to ignore your selection, and restore the original value for the Station Name.SET

Setting the Date and Time

The *Date and Time* are located on the main menu along with the Station Name. To change the Date and/or Time, navigate to the Station Name, Date/Time item and press SET. This first allows you to set the ID. Press CANCEL (as you aren't setting the ID at this time). The display will now show the "Current Time" with the cursor flashing on the seconds. Use the up, down, right and left arrow keys to set the desired date and time. Be sure to enter a time a few seconds ahead of the exact time you have from some reference clock. Then wait for the exact time and press SET complete the operation.

Setting *Time* is an important operation. Many data collection activities depend on the accurate synchronization of times between numerous data collection devices.

From that point on, the display should be in synchronization with reference time. This can be verified by watching the display for a short period.

Fields with Pre-Defined Values

Up to this point, you have learned how to program in values for menu items (fields) that require user specific data such as the time and date. In addition to these types of settings are fields which contain a limited number of pre-defined, unalterable values. In this type of menu field, the value of the field changes to the next legal value each time the up or down arrow is pressed.

For example, when setting the InputType for a measurement, pressing up and down will cycle through the list of all supported input types such as Analog, SDI, Reference, QUADSE, InternalTemp, etc. Once you have the desired value for the field, press SET to complete the change or cancel to revert back without making a change.

Fields with Pre-Defined Values and User Entered Values

Certain fields support both pre-defined values and will also allow you to enter your own values. The MeasName is an example of this type of field. When changing MeasName, the UP and DOWN arrows scroll through a predefined list of names. Pressing RIGHT lets you change any of the characters in the name in a full edit mode identical to that used to change the station name – you can change individual characters and clear out the string as desired. Once you have the desired value displayed, pressing SET will complete the change or cancel will revert back without making a change. If you create a new value as explained above, it will be added to the other pre-defined values for future selection using the UP and DOWN arrows.

Other fields of this type are Units, Sensor Names, Measurement Intervals, Measurement Times, Resistor Values, and others.

> Hint: the system keeps these pre-defined lists in a named with the extension .TXT. Separate files are used for each different type of list: names, units, etc. You can greatly simplify the setup process by editing this ahead of time and limiting it to only have the names you most commonly use.

PC Control of the 8310

When using a PC to setup the 8310, the user has a larger view into the menus as the system displays multiple menu items on the same screen with one item highlighted. Navigation within the menus can be done using the keyboard arrow keys. The system can also jump to any menu item by pressing the first letter of any item. The system still displays the "Hints" on things you can do to a highlighted menu item at the bottom of the screen. The ">" character also hints that RIGHT can be pressed for more information when the item is selected. When changing a value, you can use the full keyboard of the terminal to enter text or numbers.

The first step is to hook up the PC to the 8310 and get the communications software up and running.

Starting the PC Software

Any PC can be used as a test set as long as it has a serial port and a communications program such as HyperTerminal (for Windows Vista and Windows 7, HyperTerminal may be downloaded, here: http://www.hilgraeve.com/hyperterminal/).

> Note: if using a commercial communications program, set it for 115,200 baud, 8 bits, no parity,
> 1 stop bit. 25 lines and either ANSI or VT100 graphics.

Use a straight M-F 9 pin serial cable to connect the PC to the 8210. Use the COM1 port on the front panel of the 8310-N or the left side of the 8310-O.

If using the standard type A USB port on the PC, connect an A Male to B Male standard USB cable to any USB port on the PC.

Start the program and press ENTER. You should see the main menu displayed. If you see a prompt: "Flash Disk>," type the command UI and press ENTER.

If the 8310 still does not display the main menu, you must use the front panel of the 8310 to verify that COM1 is configured as DIRECT and that the baud rate is set to 115,200. To do this, go to Station Setup/Communications/COM1 and verify that the state is STARTED and DIRECT. Press the RIGHT arrow and verify that Baud Rate is 115,200. If it is not, press SET and then use the arrows to set the baud rate to 115,200. If you are still having difficulties, consult the Troubleshooting chapter (10) for help.

The 8310 Menu Tree

Since the PC screen is obviously much larger than the small 8310 display, it is able to give a full view of the menus as shown below.

```
          Sutron 8310: Main Menu
Station 8310C          09/24/2010 13:56:34
Recording is ON+TX              9 Meas Active
Alarm Status: NORMAL
M1.O1*: TEMP           >         23.971 C G
M2.O1: VBAT            >            13.25 G
M3.O1: VBAT_HR         >             0.00 U
M4.O1*: AirTemp        >            23.53 G
M5.O1: RelHumid        >            46.20 G
M6.O1*: Stage          >             9.95 G
M7.O1: DewPoint        >              18.44
M8.O1: testdata        >            25.46 G
M9.O1: Stage           >             0.00 U
Logged Data            >
Station Setup          >
Terminal Operations    >
Diagnostics            >
End Main
```

If you will remember, when using the front panel display to set up the 8310 you were required to push the directional arrows to move around the menu tree. When using a PC, you may also use the arrow keys or press the first letter in any item in order to move around the menu. For example, pressing L will highlight Logged Data and pressing S will highlight Station Setup. Press ENTER in place of SET and press the [ESC] key in place of OFF/CANCEL.

Selecting options and changing values

To change the value for a field, select the field using either the arrows or the first letter of the field name and press ENTER. A flashing cursor will appear in the value. Use the keyboard to change the value that is displayed. If the value being changed is in a pre-defined list, just press the first letter for the new value until the desired value appears. If you want to create a new value for a pre-defined list, use the right arrow and then enter the new value from the keyboard. The following paragraphs illustrate how the keys are used to set the *Station Name*, *Date*, and *Time*. Similar keystrokes are used to change any programmable item in any menu tree.

Setting the Station Name

The *Station Name* is the top item in the main menu unless there are errors present where it becomes the second item. The letter S is used to select this item; however, S also selects Station setup (and SD Card Operations if a card is installed). Press S until Station is highlighted (or use the arrow keys to highlight Station – then press ENTER. The cursor will flash on the current Station Name. Use the keyboard to enter a new name. You may also use the LEFT arrow to clear the string. When you've entered the desired value for the name, press ENTER to accept the entry or ESC to cancel.

Setting the Date/Time

The Date and Time are displayed and accessed on the same item as the Station Name. To change the Date/Time, press ENTER with the Station highlighted. Then press ESC to cancel a change to the name. The system will then prompt for "Current Time" with the cursor flashing on the seconds. Use the keyboard and arrows to enter the correct date and time.

Be sure to enter a time a few seconds ahead of the exact time you have from some reference clock. Then wait for the exact time and press ENTER complete the operation.

Setting *Time* is an important operation. Many data collection activities depend on the accurate synchronization of times between numerous data collection devices.

From that point on, the display should be in synchronization with reference time. This can be verified by watching the display for a short period.

Changing Pre-Defined Values

If an item has a pre-defined values, the 8310 will change the value each time the UP/DOWN arrow is pressed. If you press an alphabetic key, it will jump to the next item in the list that starts with the key you pressed. If the pre-defined list, allows you to add your own new values, pressing RIGHT will allow you to enter your own value that is added to the list.

Note that the bottom of the screen will give you hints on how to make the changes with prompts like "UP|DOWN scrolls list", "RIGHT to edit"," LEFT for top"

Terminology

Understanding some basic 8310 terminology will greatly help you operate the 8310. Take a moment to familiarize yourself with the following terms:

Measurements -- The 8310 operates to make measurements. Measurements can be as simple as a single value read from a temperature sensor or more complicated like a vector wind speed average or dew point measurement. When a measurement is set up in the 8310, it is given a name and a number. The measurement numbers are M1, M2, and so on and the name is generally something related to the value being measured – like Wind or Temperature. Each measurement has its own schedule that defines when data are measured. The complete setup for the measurement also defines what inputs are measured and how the data are converted, processed, logged, displayed, and communicated. (See section Measurements for more information)

Inputs -- Inputs are the signals from sensors or instruments (like a voltage or resistance) connected to the 8310. Depending on the type of measurement, the 8310 will need to read one or more inputs. The 8310 has built-in support for analog, digital, SDI, RS232 and other types of inputs that typically come from an external instrument or sensor. Each input is given a number to identify it in the unit. This number is generally displayed along with the measurement number in the form M1I1 (Measurement 1, Input 1). (See section Inputs for more information.

Processing – Most inputs need some kind of processing to convert the value measured (e.g. a voltage or resistance) into engineering units (like temperature or pressure). The 8310 has built-in processing for simple slope-offset calculations, polynomial, Steinhart-Hart, and table lookup to convert the RAW value measured to the desired units. Custom processing steps may be created using Basic. (See Processing for more information)

Outputs – The 8310 operates on the inputs to produce the outputs. Outputs can be displayed, logged, transmitted and used in other calculations and measurements. Some measurement types have just one output while other types have multiple outputs. Each output is given a number to identify it in the unit. This number is generally displayed along with the measurement number in the form M1O1 (Measurement 1, Output 1). Outputs also have names that are often used when the data is logged or communicated. (See Outputs for more information)

Alarms – The system supports the detection of alarms based on comparing a value with a user set hi limit, low limit and/or rate of change limit. When a value is in alarm, it is noted in the Alarm status menu. The 8310 can also be configured to transmit an alarm message when a sensor goes in to or leaves the alarm state. Alarms can be sent on various supported communications devices. The intent of the message is to keep a base station up to date on alarms without having to frequently poll for the status. (See Alarms for more information)

More on Measurements

Station Setup/Measurements lists all the measurements defined in the system with their names and status. Items are also provided for adding and deleting measurements. Each measurement in the 8310 has a number associated with it to help identify the measurement uniquely, e.g. "M2". The "*" after the measurement number indicates that the system is currently making a measurement. The data on the right gives details about when the next measurement will happen or its progress in making the measurement.

```
              Measurements (9)
M1*: TEMP        >              Sample 5 of 6
M2: VBAT         >             Next: 13:57:00
M3: VBAT_HR      >             Next: 14:00:00
M4*: AirTemp     >              Sample 4 of 6
M5: RelHumid     >             Next: 13:57:00
M6: Stage        >             Next: 13:57:00
M7*: DewPoint    >                  Executing
M8: testdata     >             Next: 13:57:00
M9: Stage        >             Next: 14:00:00
Add Measurement
Delete Measurement
Copy Measurement
Move Measurement
End Measurements
```

If you want further information about a measurement, use the arrows to display (or highlight) a particular measurement and press the RIGHT arrow. A display similar to the one below is displayed. The menu displays all the information needed to make a measurement. The "Enable" is a master on/off switch that allows you to have measurement setup but not active in the system. Depending on *Meastype* selected, you will have additional menu items to specify the times, intervals and sensor(s) you want to measure.

```
                  M1*: TEMP
MeasName                                  TEMP
Enable                                     Yes
MeasType                                Average
Interval                               00:01:00
Time                                   00:00:10
SampleInterval                         00:00:10
SampleDuration                         00:01:00
M1.I1: InputType                   InternalTemp
TempUnits                                Celsius
Processing                         Slope-Offset
Slope                                         1
Offset                                        0
Cal Slope                                     1
Cal Offset                                    0
M1.I1: Cur Val              23.9938 Celsius G
M1.O1*: TEMP                       23.981 C G
M1.O2*: TEMPMin     >                 23.98 G
M1.O3*: TEMPMax     >                 23.98 G
M1.O4*: TEMPCnt     >                  6.00 G
```

```
M1.O5: TEMPSTD      >                0.00 G
End M1*: TEMP
```

Note that there's an arrow on the menu item M1.O1 and the other output values. This arrow indicates that you can press RIGHT for more details. M1.O1 is an output value for the measurement. In the prior display, since the *MeasType* is Average which produces 5 output values: Average, MIN, MAX, Count (CNT), Standard deviation (STD). Other *MeasType* will define other outputs based on the way the *MeasType* was defined. The ">" to the right of the name suggests there's more to see for each output by pressing RIGHT.

Operating the 8310

Main Menu

The main menu for the 8310 displays important operational information and is the starting point for all 8310 users. The terminal version of the menu is shown below. Note that this menu shows the station name, date and time, recording status, data for selected sensors, and provides navigation into the logs, setup, diagnostics, etc. The main menu will display an added first line "Errors present" if there are errors that require user attention.

```
          Sutron 8310: Main Menu
Station 8310C           09/24/2010 13:56:34
Recording is ON+TX            9 Meas Active
Alarm Status: NORMAL
M1.O1*: TEMP          >          23.971 C G
M2.O1: VBAT           >             13.25 G
M3.O1: VBAT_HR        >              0.00 U
M4.O1*: AirTemp       >             23.53 G
M5.O1: RelHumid       >             46.20 G
M6.O1*: Stage         >              9.95 G
M7.O1: DewPoint       >             18.44 G
M8.O1: testdata       >             25.46 G
M9.O1: Stage          >              0.00 U
Logged Data           >
Station Setup         >
Terminal Operations   >
Diagnostics           >
End Main

             RIGHT to view log | ENTER to measure live
```

Errors

If the 8310 encounters a problem or error in the course of its operation, it will activate the "Errors present" item at the top of the main menu. If you should see this item, press RIGHT to see the errors. Use the troubleshooting section to help understand and resolve each error. You should clear the errors before leaving the station.

Recording

The main menu will show "Recording is OFF", "ON" or "ON+TX". When Recording is OFF, the 8310 is not automatically collecting data or transmitting the data. It is waiting to be setup and/or have the Recording turned ON. When Recording is ON it is automatically collecting data based on the setup. Recording ON+TX will be displayed if the setup contains some communications devices configured to automatically transmit data.

Always check to make sure Recording is ON or ON+TX before leaving a site!

SD card

If you insert an SD card when the display is turned off, it automatically turns on and prompts for a download of the data. Whether you proceed with the download or cancel, the system now has a new SD Card Menu added to the main menu. If the display is already on when the card in inserted, the display does not change but the additional SD Card Operations is added to the Main Menu.

```
SD Card Operations
Download log to card
Write setup to card
Read setup from card
Write basic to card
Read basic from card
Format SD card
End SD Card Operations
          Press ENTER to download
```

The SD card supports log files, reading/writing setups and basic programs. Most stations will have a minimum of two log files. The system.log is where the system keeps error, status and operational messages. The station data is normally kept in a separate log file, named data.log or given some other name. When you download the data, you should generally download both the system and data logs. The software names the files on the SD card with the station name, name and date that is being downloaded.

Viewing Outputs

Some outputs can be viewed in the main menu right after the alarm status. Normally, they are the last measured value for the key sensors at the station. Not all the outputs will show up in the main menu. The outputs in the main menu are those that were enabled when the output was configured. Note the outputs are identified by the measurement and output number along with the output name. A "*" next to the output number means that the system is currently measuring the input.

```
M1.O1*: TEMP          >            23.9 C G
M2.O1: VBAT           >             13.25 G
M3.O1: VBAT_HR        >              0.00 U
M4.O1*: AirTemp       >             23.53 G
M5.O1: RelHumid       >             46.20 G
```

The outputs can also be viewed from the /Diagnostics/Outputs menu. This menu gives a full listing of all the outputs regardless of whether or not they were enabled for display.

```
          Outputs (3)
M1.O1: Stage      >        2.15 G
M2.O1: VBAT       >       13.81 V G
M3.O1: AirTemp    >        2.03 G
End Outputs

   ENTER to measure live | RIGHT to view log
```

Note that the hint suggests pressing RIGHT to view the log. You can get to the logged data from here as well as from the main menu and several other menus in the 8310.

Viewing Logs

With one of the outputs selected in the main menu (e.g. M2.O1) or Diagnostic/Outputs menu, pressing RIGHT will allow the viewing of the data in the log (as the hint suggests). You can also view the logs by using the *Logged data* item in the main menu.

```
    Logged Outputs - ? for Help
09/24/2010 15:00:00 VBAT 13.81 G
09/24/2010 15:15:00 VBAT 13.69 G
09/24/2010 15:30:00 VBAT 13.81 G
09/24/2010 15:45:00 VBAT 13.81 G
09/24/2010 16:00:00 VBAT 13.81 G
09/24/2010 16:15:00 VBAT 13.69 G
09/24/2010 16:30:00 VBAT 13.81 G
09/24/2010 16:45:00 VBAT 13.81 G
```

Once in the log, you can use the arrow keys to navigate up and down through the data. Pressing "?" displays help showing special keys to quickly move through the log.

Special keys for viewing logged data:

```
space - Page Down      backspace - Page Up
   b - Beginning           e - End
   h - Hour+             H - Hour-
   d - Day+              D - Day-
   w - Week+               W - Week-
   m - Month+              m - Month-
   y - Year+             Y - Year-

Press Enter to continue:
```

Diagnostics

Diagnostics are selected from the main menu. The diagnostic menu items give quick navigation to look at all the inputs, outputs, communications and status of the system. The Diagnostic menu also includes SDI tools.

```
            Diagnostics
Communications (3)   >
Inputs (3)         >
Outputs (3)        >
I/O Modules (3)     >
SDI Tools          >
System Status       >
Basic Status: RUN
Selftest
Clear Cal Data
Debug to System Log                 No
Upgrade Firmware
Exit 8310 application
End Diagnostics

        RIGHT shows details
```

Diagnostics/Inputs

When you select Inputs, you can view the last measured value from each input. Note that the menu lists the Measurement number, input number, I/O connection along with the value. For most inputs, you can force a live measurement by pressing SET/ENTER. You can also Calibrate, examine the I/O configuration, check mux settings (if used), change the setup, and view the Raw value by pressing RIGHT.

```
                Inputs (3)
M1.I1: AIO1:1        >          2.14989 V G
M2.I1: Battery       >          13.8101 V G
M3.I1: AIO1:2        >          2.03278 V G
End Inputs

         RIGHT more, ENTER measure


              M2.I1: Battery
M2.I1: Calibrate                13.8101 V G
M2.I1: I/O Config                   Battery
M2.I1: Raw Val                  13.8101 V G
M2.I1: Setup         >
End Menu

            ENTER to calibrate
```

Diagnostics/Outputs

```
                Outputs (3)
M1.O1: Stage         >              2.15 G
M2.O1: VBAT          >            13.81 V G
M3.O1: AirTemp       >              2.03 G
End Outputs

     ENTER to measure live | RIGHT to view log
```

Note that the hint suggests pressing RIGHT to view the log. You can get to the logged data from here as well as from the main menu and several other menus in the 8310.

Communications

The 8310 has built-in 4 communications ports. The status of the ports can be viewed in the Diagnostics/Communications menu as shown below. Only those ports that have been configured will show up in the list.

```
Communications (3)
COM1: (Standby-On)                Direct
COM2: (Standby-On)                SATLINK
LAN (Standby-On)    >
Reset Com Device
End Communications
                  RIGHT to Test
```

Pressing RIGHT provides a test menu specific to the type of communications device. For example, the test menu for SATLINK allows you to display messages, make test transmissions, view the status, and perform other important operations:

```
               Satlink COM2 Test
SelfTimed message    >
Random message       >
Send to Sutron       >
Satlink Status
Clear status
Reset Failsafe
Reset Satlink
Set factory defaults
End Satlink COM2 Test
               RIGHT shows details
```

With SelfTimed message highlighted you can press RIGHT and see the details:

```
SelfTimed message
:Stage 105 #15 M M M      ***press RIGHT to scroll through the message
Num chars = 605            Num secs = 16.96
End SelfTimed message

DOWN: message stats
```

Setups

After the 8310 is powered up, it will read a setup into memory and then use it to configure devices, communications, measurements, logging and transmissions. The setup is stored on the 8310's internal flash disk with the name 8310.ett. You can load setups into the 8310 either manually or via the SD card, Terminal Menus or some communication devices.

As you make changes to the setup, the changes are automatically stored in this 8310.ett file. A backup copy of the prior is kept in 8310.ett.bak.

You can also have other setup files on the flash disk; however, they are not used until they are imported (Station Setup/Import) or renamed to 8310.ett (via command line). Import also allows you to read a setup from an SD card or other location, and store it on the flash disk.

The Station Setup/Clear Setup function will set all values to their default state. Note: this won't normally change the kinds of communications devices assigned on COM2 and COM3, but will reset the setup values associated with those ports to their default state (e.g., clear dial-in and dial-out messages, etc.).

USE CAUTION WHEN CLEARING THE SETUP REMOTELY!!!

When clearing the setup remotely, communication settings will reset to their defaults. If you are connected via one of these ports, you will you're your connection, and may NOT BE ABLE TO RECONNECT, unless the default settings for the port support remote access!

The Setup LIST Command

The setup LIST command types out the complete setup of the 8310 in a formatted, readable output. The command is issued via the command line interface.

The LIST output closely matches the 8310 menus, making it simple to use as a reference when entering a setup.

Chapter 4:
Menu Tree Reference

This chapter describes in detail all the items that make up the 8310 setup. The chapter is not meant to be read from front to back but is intended as a reference.

8310 Menu Reference

Each Menu item in the 8310 is documented in the following sections. First, all the items of the Main Menu are documented followed by each of the sub menus in alphabetical order. The items within each menu/sub-menu are listed in alphabetical order based on the front panel name. Each Menu item is described in a separate section identified by its name and Menu Path.

At the top of each page is a header that contains the menu path for one of the items described on the page. You can look at this header while turning pages to help you find a particular menu and item.

The items in a sub-menu are described in sequential order.

The menu path shows all the menus you must use to select a particular item. The Main Menu is implied in the menu path. The following are some examples menu paths:

Example 1: Station Setup/Measurements/Mx /Mx.Ox

Navigation:

From Main Menu, select Station setup

Then select Measurements

Then select a specific measurement Mx

Then select a specific output Ox

Note: select means to highlight and then press RIGHT

Example 2: Station Setup/Communications/COMx SATLINK/SelfTimed Settings

Navigation:

From Main Menu, select Station setup

Then select Communications

Then select a specific Communications port COMx

Then select a SelfTimed Settings

Main Menu

The main menu for the 8310 displays important operational information and is the starting point for all 8310 users. The terminal version of the menu is shown below. Note that this menu shows the station name, date and time, recording status, data for selected sensors, and provides navigation into the logs, setup, diagnostics, etc. The main menu will display an added first line "Errors present" if there are errors that require user attention.

```
          Sutron 8310: Main Menu
Station GreenRiver      09/24/2010 13:56:34
Recording is ON+TX            9 Meas Active
Alarm Status: NORMAL
Sending Alarm Txs:                    VOICE2:
M1.O1*: TEMP          >          23.971 C G
M2.O1: VBAT           >             13.25 G
M3.O1: VBAT_HR        >              0.00 U
M4.O1*: AirTemp       >             23.53 G
M5.O1: RelHumid       >             46.20 G
M6.O1*: Stage         >              9.95 G
M7.O1: DewPoint       >             18.44 G
M8.O1: testdata       >             25.46 G
M9.O1: Stage          >              0.00 U
Logged Data           >
Station Setup         >
Terminal Operations   >
Diagnostics           >
End Main
```

A short description of each item in the main menu is provided below. Detailed information on each item can be found in separate headings with names identical to the item.

Station Name/Date/Time

The user selected name is displayed along with the current date and time. The name is used to uniquely identify the 8310 to the user and is also used in various reports and communications. The date is in MM/DD/YYYY format and the time is in 24 hour format. The time may be local time or GMT/UTC. The name/date/time can be changed from this item.

See Station Name/Date/Time for more information.

Recording

The proper state for Recording is ON or ON&TX. When recording is OFF, the unit is in a setup mode and will not perform scheduled operations. The state of recording can be changed from this item.

See Recording for additional information.

Alarm Status

Alarm status can be Normal, Alarm, or Alert.

See Alarm Status for additional information.

Sending Alarm Txs

One or more "Sending Alarm Txs" will appear when a Speech Modem, LOS radio, or other SSP device (Direct Connect, SSP, RS-485) is transmitting an alarm. The name of the device sending the alarm is also displayed (ex: VOICE2:). Pressing set will acknowledge the alarm on that device and prevent further transmissions until a new alarm is triggered. "DISABLED" will be displayed if alarm transmissions have been disabled by for instance a voice modem user or a Basic program. In this case, pressing set will re-enable alarm transmissions.

Mx.Ox

The main menu shows the last measured value for any output configured with DISPLAY=YES. The value may optionally include units and a quality flag. If there is a "*" after the MxOx label, it means that the measurement is currently underway.

The values for the Quality may be:

"G" for Good

"B" for Bad

"U" for Unknown (Not yet measured)

This item may also be used as a shortcut to view the logged data for the sensor by pressing RIGHT or ENTER.

Logged Data

Logged Data is a sub-menu that displays all available log Files, allowing the user to select a log to view.

See Logged Data for additional information.

Station Setup

The Station Setup menu provides a way to perform most of the essential functions needed to set up an 8310. The station setup menu includes items for measurements, communications, LAN settings, etc.

See Station Setup for additional information.

Terminal Operations

The Terminal Operations menu is only available on a PC/terminal – it is not available from the front panel.

See Terminal Operations for additional information.

Diagnostics

Diagnostics are selected from the main menu. The diagnostic menu items give quick navigation to look at all the inputs, outputs, communications and status of the system. The Diagnostic

menu also includes SDI tools.

See Diagnostics for additional information.

Alarm Status

The possible values for *Alarm* status are:

NORMAL	No alarm conditions exist or all alarm conditions have been cleared temporarily.
ALARM	Means one or more output values met the alarm criteria configured for it. The system will retain this state until the condition is cleared. Alarms can be configured for any output by using a device sub menu. SSP based devices all use a common format for transmissions, and IsSSPCurData should be set to Yes to include an output in this transmission and to enable alarm configuration. Once this has been set, you may enter any of the available device menus and set Enabled to Yes, and Set TxAlarmMode to TxIn or TxInAndOut to allows alarm notifications to be sent to the selected device. The output will be in alarm if it is greater than a user set HiLimit, less than a user set LowLimit, or there is a change greater than a Rate of Change limit. See *Understand Alarms*and Alarm Transmissions for a complete description of Alarms and Alarm transmissions. Note: Satlink has its own settings that control the random transmissions. These settings are independent from those used for Alarms.

A hint will prompt for additional action such as:

Disable -- Stops all alerts
Clear – sets status to Normal until input is measured again.

Logged Data

Logged Data is a sub-menu that displays all available log files, allowing the user to select a view. By default, the data.log is highlighted as it normally contains data collected by the system.

Once a logged is selected, the data is displayed as shown below:

```
Logged data: /Flash Disk/Data.log - ? for Help
09/24/2010 15:00:00 VBAT 13.81 G
09/24/2010 15:15:00 VBAT 13.69 G
09/24/2010 15:30:00 VBAT 13.81 G
09/24/2010 15:45:00 VBAT 13.81 G
09/24/2010 16:00:00 VBAT 13.81 G
09/24/2010 16:15:00 VBAT 13.69 G
09/24/2010 16:30:00 VBAT 13.81 G
09/24/2010 16:45:00 VBAT 13.81 G
```

You can use the arrow keys to navigate up and down through the data. Pressing "?" displays help, showing special keys to quickly move through the log.

```
Special keys for viewing logged data:

space - Page Down       backspace - Page Up
   b - Beginning            e - End
   h - Hour+              H - Hour-
   d - Day+               D - Day-
   w - Week+                W - Week-
   m - Month+               m - Month-
   y - Year+              Y - Year-

Press Enter to continue:
```

Note: you can also go straight to the log data for a particular output directly from the Mx.Ox: items in the main menu.

Recording

Recording Status can be OFF, ON or ON&TX. When OFF, the 8310 will not perform any of its scheduled functions. Automatic Satellite transmissions, LOS radio alarm transmissions, and telephone alarm transmissions are disabled when recording is OFF. It may still be able to communicate with other systems, depending on the device; however, the data it sends will not be updated to reflect current measurements.

When the *Recording Status* is changed to ON, it may do some initialization of sensors and interfaces as needed to operate automatically. The status will show ON&TX if one of the optional communications devices such as Satlink, IRIDIUM or GPRS is configured to make automatic transmissions.

With *Recording* set to ON, the 8310 will use the schedule information to measure sensors, log data, run the basic program, and make transmissions.

If you leave a site without setting *Recording* ON, the site will not collect new data. For this reason, it is vital that you set *Recording* to ON as soon as the system has been setup.

As a safety measure, if recording is OFF and you turn the display OFF, the system will flash you the warning message "Recording is Off" to remind you that you are leaving the 8310 in a non-operational mode and prompt you to start it.

Errors encountered when the system is operating are displayed in the Errors item of the main menu.

SD Card Operations

This function provides the following sub-menu with a selection of commands that can be used to initiate the uploading or downloading of data to, or from an SD

Upgrade Firmware	Starts a process to update the SW in the 8310. The update process typically takes about a minute
Download log to card	Writes data in a log to the SD card
Write setup to card	Writes the current setup to the SD card
Read setup from card	Reads a setup from the SD card
Write basic to card	Writes a BASIC program to the SD card
Read basic from card	Reads a BASIC program from the SD card
Format SD card	Formats/erases the SD card

Each function is discussed in its own section

SD Card Operations/Format SD Card

This function prepares an SD card to receive data from the 8310. Most SD cards are already formatted and ready for 8310 data and do not need additional formatting.

SD Card Operations/Read Setup from Card

Read Setup from Card is used to load a new setup from a stored on the SD card. This will overwrite any existing setup and reconfigure the 8310 based on the setup file. Pressing the SET key with this option highlighted will cause the 8310 to prompt you for the name of the file to load. The system looks in the "SD Card/8310" directory by default. You may navigate to other directories by pressing UP, DOWN, and SET. When you find the setup you want to load, press SET with it highlighted, and the 8310 will read the file and use it as the current setup.

SD Card Operations/Write Setup to Card

Write Setup to Card is used to write a copy of the 8310 setup to the SD card. The SD Card can then be taken to another 8310 and cloned by using the Read Card Setup option (above). Pressing the SET key will cause the system to first display the intended name for the setup file. This will be "/SD Card/8310/stationname.ett". The name can be changed using the arrow keys. After pressing SET again, the system displays the message "Reading Setup, Please wait…" After a few seconds, the system returns to the "Write Setup to Card" menu.

SD Card Operations/Read BASIC from Card

Read BASIC from card is used to read a copy of one or more of the basic programs from the SD card into 8310 memory. Pressing the SET key results in the following:

- All basic programs are stopped
- The system prompts to delete all basic programs currently in memory (careful here: answer yes, only if you are trying to replace the current basic program set with new)
- For each basic program found on the SD Card, the system prompts whether to read the file into memory:
- All basic programs in memory are run.

SD Card Operations/Write BASIC to Card

Write BASIC to card is used to write copies of the basic programs in memory to the SD card. The SD Card can then be taken to another 8310 and cloned by using the *Read BASIC from card* option (above). Pressing the SET key will write each basic program in memory to a directory named "8310" on the SD Card. If the file already exists, you will be prompted whether you wish to overwrite. Once all files have been written, the system prompts "Write basic has completed", and "Press SET to continue".

SD Card Operations/Upgrade Firmware

This item is visible only when the Flash Disk or SD Card contains a firmware upgrade for the 8310. Press SET to start the upgrade process. The system will prompt whether to upgrade with the files found. The system will reboot when the upgrade is complete. See Upgrading the Firmware in Chapter 12, for more information.

Station Name/Date/Time

Station Name

The *Station Name* is used by the software to uniquely identify the 8310 to the user and to other systems in a network. The name appears optionally in the header of downloaded data files, and is used to identify the data source for data dumped to the SD Card, serial port, and in SSP communications. In these contexts, *Station Name* is often used as part of a filename. Hence, the characters offered when editing *Station Name* are limited to valid filename characters.

Date and Time

The Date and Time are displayed in the same item as the *Station Name*. The Date/Time represents the current 8310 clock time. All 8310 functions are performed relative to this *Time* and the *Date* (see above). Therefore, an effort should be made to keep them accurate. The *Time* is used as a reference for initiating measurements and for sampling. Changing the time affects only when the next sampling or measuring cycle will start. It will not stop the current functions. However, altering the time setting may cause the 8310 to skip a sampling or measuring cycle if the new time set skips the interval or does not permit the current functions to complete before the next interval begins.

When setting the time, be sure to enter a time a few seconds ahead of the exact time you have from some reference clock. Then wait for the exact time to press SET or ENTER.

Setting *Time* is an important operation. Many data collection activities depend on the accurate synchronization of times between numerous data collection devices.

From that point on, the display should be in synchronization with reference time. This can be

verified by watching the display for a short period.

The Date and Time can also be set via command line, SSP and BASIC.

Station Setup

The *Station Setup* menu provides a way to perform most of the essential functions needed to set up an 8310. A typical Station Setup menu is provided below:

```
          Station Setup
Measurements (9)   >
Basic              >
Communications (4) >
Logs (2)           >
Log Records (1)    >
LAN Settings       >
Users (0)          >
Advanced Settings  >
Read setup from file
Write setup to file
Clear setup
Save formatted setup
End Station Setup
```

The items in the station setup menu provide a means to set up the following submenus:

Measurements () >
The number in parenthesis is the number of measurements enabled. Press RIGHT or ENTER to enter the measurements sub-menu. See Station Setup/Measurements for more information.

Basic >
Press RIGHT or ENTER to enter the Basic sub-menu. See Station Setup/Basic for more information.

Communications () >
The number in parenthesis is the number of communications ports enabled. Press RIGHT or ENTER to enter the communications sub-menu. See Station Setup/Communications for more information.

Logs () >
The number in parenthesis is the number of log files on the flash disk. Press RIGHT or ENTER to enter the log sub-menu. See Station Setup/Logs for more information.

Log Records () >
The number in parenthesis is the number of log records defined in the system. Press RIGHT or ENTER to enter the log records sub-menu. See Station Setup/Log Records for more information.

LAN Settings >
LAN settings configure the Ethernet port. Press RIGHT or ENTER to enter the LAN settings sub-menu. See Station Setup/LAN Settings for more information.

Users () >

The number in parenthesis is the number of users defined in the system. Press RIGHT or ENTER to enter the user's sub-menu. See Station Setup/Users for more information.

Advanced Settings >

Advanced Settings contains settings for rarely used station settings. Press RIGHT or ENTER to enter the log sub-menu. See Station Setup/Advanced Settings for more information.

Read setup from file

This function reads a setup from SD card or flash disk and makes it the current setup.

Write setup to file

This function writes the current setup to an SD card (or other location on the Flash Disk, if you specify).

Clear setup

This function clears the current setup and sets all values back to default. It creates a blank slate for starting a completely new setup. Note: this won't change the kinds of communications devices assigned on COM2 and COM3, but will reset the setup values associated with those ports to their default state (e.g., clear dial-in and dial-out messages, etc.).

When clearing the setup remotely, communication settings will reset to their defaults for devices installed on COM2 and COM3. If you are connected via one of these ports, you may need to reconnect to the station after clearing the setup!

Save formatted setup

This function prompts for a filename and then saves the current setup in a file formatted in such a way to make it easy to read.

Station Setup/Measurements

```
          Measurements (9)
M1*: TEMP      >          Sample 5 of 6
M2: VBAT       >         Next: 13:57:00
M3: VBAT_HR    >         Next: 14:00:00
M4*: AirTemp   >          Sample 4 of 6
M5: RelHumid   >         Next: 13:57:00
M6: Stage      >         Next: 13:57:00
M7*: DewPoint  >             Executing
M8: testdata   >         Next: 13:57:00
M9: Stage      >         Next: 14:00:00
Add Measurement
Delete Measurement
Copy Measurement
Move Measurement
```

End Measurements

Mx[*]: name status >

Each measurement is listed with its ID (e.g.M1), "*" if it is being measured, and information on the status of the measurement. Status can be one of the following values:

Executing – currently being measured

Next: HH:MM:SS – waiting until the specified time to be measured.

Sample x of y – measurement includes averaging or an accumulation, and the system has taken x out of a total of y samples.

Press RIGHT to view/change the details of the selected measurement.

Add Measurement
This function adds a new measurement to the system.

Delete Measurement
This function deletes a measurement from the system. A menu of the available measurements is displayed and a measurement is deleted by selecting a measurement and pressing SET or ENTER.

Copy Measurement
This function makes a copy of an existing measurement. Select the measurement you wish to make a copy of, and the system will prompt you for a new name, and new mux channels if being used.

Move Measurement
This function may be used to rearrange the order of measurements. Select the measurement you wish to move and then by pressing the UP and DOWN arrows a new position may be selected.

Station Setup/Measurements/Mx

This menu gives all the information needed to make a specific measurement. A typical display is provided below. The "Enable" is a master on/off switch that allows you to have measurements set up but not active in the system. Measurement Types (*MeasType*) have been defined for instantaneous measurements, averages, vector averages, and others. Depending on *MeasType* selected, you will have additional menu items to specify the times, intervals and sensor(s) you want to measure.

```
          M1*: TEMP
MeasName                TEMP
Enable                  Yes
MeasType                Average
Interval                00:01:00
Time                    00:00:10
SampleInterval          00:00:10
SampleDuration          00:01:00
```

```
M1.I1: InputType          InternalTemp
TempUnits                 Celsius
SwitchedPwr       >           None
Processing              Slope-Offset
Slope                     1
Offset                    0
Cal Slope                   1
Cal Offset                  0
M1.I1: Cur Val        23.9738 Celsius G
M1.O1*: TEMPAvg             23.981 C G
M1.O2*: TEMPMin    >         23.96 G
M1.O3*: TEMPMax    >         23.99 G
M1.O4*: TEMPCnt    >         6.00 G
M1.O5: TEMPSTD     >         0.01 G
M1.O6: TEMP        >        23.97 G
End M1*: TEMP
```

The *MeasType* is Average, which produces 6 output values: Average, MIN, MAX, Count (CNT), Standard deviation (STD), and the last sampled value. Other *MeasTypes* will have different outputs.

Note that there's an arrow on the menu item M1.O1 and the other output values for this measurement. Press RIGHT to enter the output menu for each output shown. This is where you choose what you want to do with each output- you can log, transmit, add processing steps, choose the number of decimal places, and more.

The following table shows the details of each item in this menu. Note that the table has many field dependent values. They are shown indented and are only present based on a field value above it.

MeasName

Value: String

Description: *MeasName* is an editable, pre-defined string (names.txt). This name becomes the basis of the output name.

Enable

Value: YES | NO

Description: If *Enable* is YES, the system will make measurements according to the setup. If Enable=NO, no measurements will be made. This allows you to create a super setup for the station and only enable those sensors that may be present.

MeasType

Description: The 8310 has a growing list of measurement types that provide to support special measurement and processing needs. Each *MeasType* may have its own configuration

dependent values.

Instantaneous

Takes a single measurement, produces a single output.

Interval, Time

Interval and *Time* together define when measurements should be taken. *Interval* is the time between measurements, and *Time* is an offset from *actual* time, both in format of HH:MM:SS. For example, if *Time* is set to 00:00:00 and *Interval* is 00:15:00, measurements will be made right on the hour, at 15 past, at 30 past, and at 45 past the hour. Another example: with *Time*=00:00:45 and *Interval* = 00:01:00, measurements will be taken every minute, but they will be taken when the actual time reads 45 seconds past the minute.

Average

Takes multiple measurements, produces outputs of average, min, max, standard deviation and count, as well as time of min and time of max (expressed in terms of seconds into the day).

Interval, Time, Sampleinterval, SampleDuration

Used when averaging is specified. *SampleInterval* specifies the time between samples while *SampleDuration* specifies how much sampling to do before producing the average. Sampling starts at *Time* + *Interval* – *SampleDuration* + *SampleInterval*, and the last sample is taken at *Time* + *Interval*.

For example, with *Time*=00:03:00, *Interval*=00:20:00, *SampleInterval*=00:01:00 and *SampleDuration*=00:10:00, the system would start its first sample at 00:14:00 and take samples every 1 minute until 00:23:00, at which time it would compute the average of the 10 samples. The timestamp given to the average would be 00:23:00, and the measurement cycle would start again, producing subsequent averages with timestamps of 00:43:00, 01:03:00, 01:23:00, 01:43:00, etc. A visual representation of the example is below. Each arrow represents a sample.

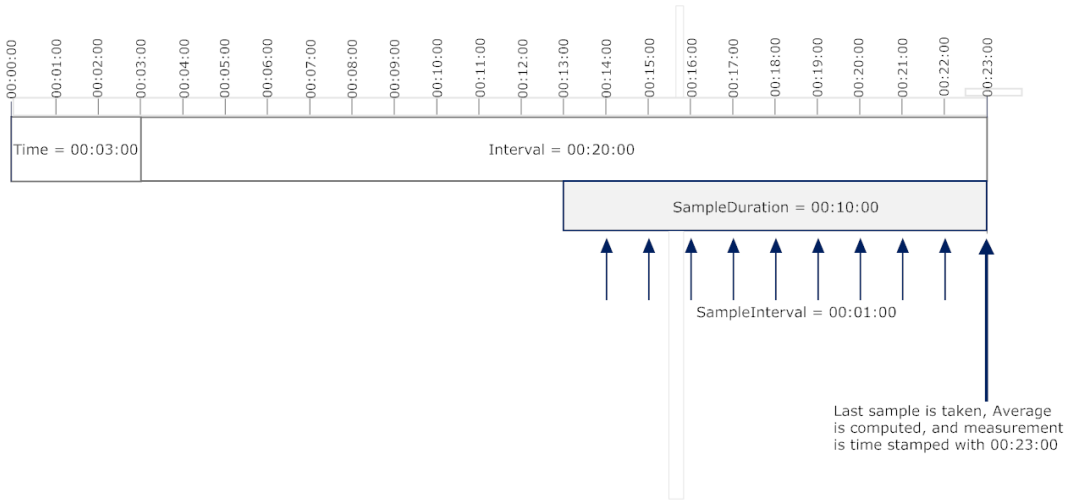


Figure 1 Sampling and Averaging

Progressive

When Progressive is enabled, the outputs are updated as each sample is taken.

VectAverage

The Vector Average is important to any sensor that has a circular discontinuity, such as a wind direction sensor with the crossover from 0 to 359 degrees. In these cases, simple averaging does not work -- the mean of 0° and 359° is 179.5°, which is clearly incorrect. Calculating a vector average provides a way around this problem.

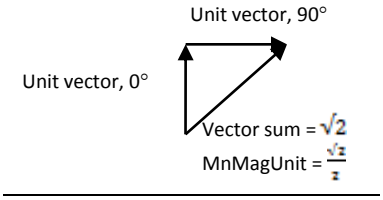
Vector Average uses the same values that Average uses (*Interval*, *Time*, *SampleInterval* and *SampleDuration*) to control when measurements are made.

There are several types of vector averages, explained below, each conveying slightly different information. This block is, in fact, geared toward wind sensors, but it could be used any time performing a vector average is desired. When wind speed is described (e.g. "23 mph out of the northwest", this is often an expression of the Mean Speed Scalar and the Mean Direction Unit.

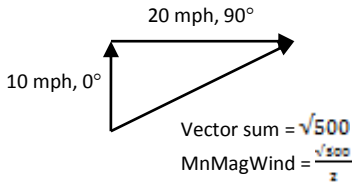
The outputs of Vector Average are as follows, with vector math shown below.

Mean Speed Scalar – This is the scalar wind speed, not taking direction into account. The scalar average of 10mph for an hour and 20mph for an hour is 15mph, regardless of changing direction.

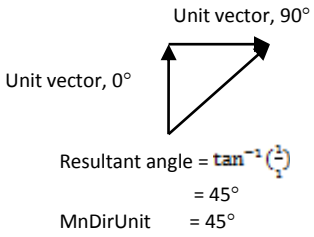
Mean Magnitude Unit – This is the vector average of the wind speed using unit vectors. The mean magnitude unit of 5mph at 0° for 1 hour and 100mph at 90° for 1 hour is 0.707. This is found by adding the two vectors, finding the magnitude of the resultant vector, and dividing by the number of vectors in the average (two, in this case). Since the mean magnitude unit is an average of unit vectors, it will always be between 0 and 1.



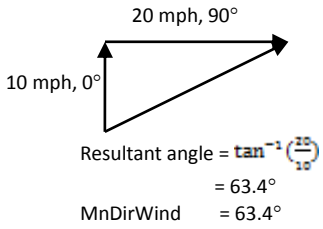
Mean Magnitude Wind – This is the vector average of the wind speed which takes direction into account. Here, the average of 10mph at 0° for 1 hour and 20mph at 90° for 1 hour is 11.2 mph.



Mean Direction Unit – This is the wind direction (in degrees) not weighted for wind speed. Here, the average of 10mph at 0° with 20mph at 90° is 45°.



Mean Direction Wind – This is the wind direction (in degrees) weighted for wind speed. Here, the average of 10mph at 0° with 20 mph at 90° is 63.4°.



STD Speed Scalar – This is the standard deviation of the scalar wind speed.

STD Direction Unit – This is the standard deviation of the direction unit.

STD Direction Wind – This is the standard deviation of the direction wind.

Min Speed Scalar – This is the minimum of the scalar wind speed.

Max Speed Scalar – This is the maximum of the scalar wind speed.

Max Direction – This is the direction taken at the time the max speed is detected.

Count – This is the number of samples that have been taken.

Speed – This is the instantaneous speed, available after every sample.

Dir – This is the instantaneous direction, available after every sample.

Accumulate

Takes multiple samples of an input and keeps a running total (accumulation) as set by the properties. The three outputs available are:

A) The current accumulation, updated at each sample interval and designated by adding "Acc" to the measurement name, such as ExampleAcc.

B) The instantaneous sample used to compute the accumulation, available at every *SampeInterval,* and referred to as simply the masurement name, such as Example. Note that the sample data is affected by the input processing step (Mx.Ix Processing), but it is not affected by the accumulation parameters of *Threshold*, or *WeightForTime.*

C) The previous accumulation, updated at the completion of a complete measurement interval, and designated by adding "PrevAcc" to the measurement name, such as ExamplePrevAcc.

Properties used by *Accumulate* are described below:

UseThreshold

YES/NO. When YES, allows user to enter threshold value for comparison against incoming sample (*AccumEvent* determines what happens as a result of the comparison). When NO, no threshold test is performed on incoming sample.

Threshold

When *UseThreshold* is YES, the input is compared to threshold as a part of the accumulation process. If *AccumEvent* is yes, the input is changed to a 0 or 1. This is useful for counting the number of times an input exceeds a value as is needed for sunshine duration accumulations. If accumevent is no, the input is added to the prior accumulation only when it exceeds threshold. This is useful for totalizing measurements where you want to ignore values below threshold.

AccumEvents

YES/NO -- only applicable/shown when *UseThreshold* is YES. When YES, add 1 to accumulation if sample >= threshold, else add 0. When NO, accumulate sample only if sample >= threshold.

SampleInterval

Defines how often to take a sample. The input processing step (Mx.Ix Processing) is first applied, and then the threshold test is applied to each sample. The result is then added to the current accumulation. Processing steps defined for an output are executed after all threshold and time-weighting computations have taken place. These values are available as an output and can be referenced by other measurements.

Interval, Time

The accumulation is reset to 0 according to *Interval* and *Time*, as described above for Instantaneous measurements. If Interval is 00:00:00, the accumulation is never reset.

WeightForTime

When *WeightForTime* is YES, the system multiplies the input by the deltatime in minutes for a time weighted accumulation. Use a processing step on the output to convert the time base from minutes to hours (multiply by 1/60) or seconds (multiply by 60)

Here's the overall logic for the accumulation calculation.

UseThreshold	AccumEvent	WeightForTime	Calculation
N	D	N	Sum(x)
N	D	Y	sum(x * interval)
Y	N	N	sum(x, x>t)
Y	Y	N	sum(0|1, 1: x>t)
Y	Y	Y	sum(0|1 * interval, 1: x>t)
Y	N	Y	sum(x * interval, x>t)

Y=YES, N=NO, D=Don't care

Example:

Hours sunshine accumulation: sample input every 10 seconds, accumulate time when input > threshold, log every 2 minutes, reset every day. This requires 2 measurements, one to do the accumulation with 24 hour reset and the other to log it every 2 minutes.

Measurement 1: Sample pyranometer every 10 seconds accumulate for 24 hours, with reset at midnight:

Name: Sunshine

MeasType: accumulate

Sample Interval: 00:00:10

Interval: 24:00:00

Time: 00:00:00

Threshold: 120 watts/meter^2

WeightForTime = YES

AccumulateEvent = YES

Input Type/Slope/Offset: as needed to sample the input and convert it to watts/meter^2

M1.O1 minutes sunshine (use processing:linear with slope of 0.016667 if you want the value in hours sunshine (hrs = min*1/60))

Display=YES

Log=NO

Measurement 2: Sample M1.O1 every 2 min and log/transmit it

MeasType: instantaneous

Input type: Reference (M1.O1)

Time: 00:00:00

Interval: 00:02:00

M2.O1

Log=YES

DewPoint

Takes a sample of air temperature and relative humidity, computes dew point and has outputs of air temperature, relative humidity and dewpoint. The calculation is done according to "WMO Guide to Meteorological Instruments and Methods of Observation" WMO-No.8 seventh edition, 2006. The equation is:

a = (ln(r/100)/17.62) + (t/(t + 243.12))
DewPoint = a * 243.12/(1-a)

Where r is percent RH (0-100), t is air temperature in C, and ln is log base e or natural logarithm. The calculated DewPoint is in C as well.

This measurement has the following properties:

Interval, Time

Define when the measurement task runs. (See details under Instantaneous)

TempUnits

Specify if the AirTemperature and DewPoint are to be expressed in Fahrenheit or Celsius.

Input Type (AT)

Specifies the input type and associated fields for making the temperature measurement.

Input Type (RH)

Specifies the input type and associated fields for making the humidity measurement.

DiffResistance (Differential Resistance)

This measurement type is used to measure Differential Resistance sensors, such as those made by Carlson Concrete Instruments for Dam Safety and concrete structure monitoring applications, where stresses and strains on the structure are monitored and recorded, and is typically used in combination with the Differential Resistance input type.

This measurement takes two inputs, Rt and Z, and produces four outputs, Out, t, Rt, and Z. "Out" is typically a computed stress/strain or displacement, "t" is temperature, and Rt and Z are reflections of the inputs.

This measurement has the following properties:

Interval, Time

Define when the measurement task runs. (See details under Instantaneous)

K, R0, f, b

These values come directly off the sensor's cal sheet. When measuring temperature only, set f and b to 0.0.

Z0, t0

Determined at the time of installation. When measuring temperature only, set f and b to 0.0.

Input Type (Rt)

Specifies the input type to use for the Rt parameter of the temperature calculation used to produce this measurements temperature (t) output: t = K * (Rt – R0). This input type is typically set to DiffResistance, with its corresponding DiffResParam property set to "R1+R2".

Note: when using the DiffResistance input type for both Rt and Z, set the Module, Channel, Mux, and MuxChannel properties the same for both inputs.

Input Type (Z)

Specifies the input type to use to for the Z parameter of the calculation used to produce this measurements Out value: Out = f * (Z – Z0) + b * (t – t0). This input type is typically set to DiffResistance, with its corresponding DiffResParam property set to "R1/R2".

Note: when using the DiffResistance input type for both Rt and Z, set the Module, Channel, Mux, and MuxChannel properties the same for both inputs.

Evapotranspiration

Calculates daily potential evapotranspiration using the American Society of Civil Engineers standardized reference evapotranspiration equation (January 2005) using 5 (normally averaged) input values:

1. Temperature in degrees C or degrees F
2. Relative humidity expressed as percent
3. Barometric pressure in millibars or inches of mercury
4. Wind speed in kilometers per hour, miles per hour, meters per second, knots, or feet per second
5. Solar energy in Langleys (cal/sq-cm/min), or Watts/sqare meter

The ET calculation can output any of three options:

- ETo – Standardized Reference Evapotranspiration, Short (grass)
- ETr – Standardized Reference Evapotranspiration, Tall (alfalfa)
- Water surface – Same as ETo except uses albedo of 0.06, characteristic of open water

The calculation method used in the block is based on:

Me. Jensen, R. D. Burman, and R. G. Allen 1990.
Evapotranspiration and Irrigation water Requiremtnts
ASCE manuals and Reports on Engineering Practice NO.70
American Society of Civil Engineers NY 1-332

Walter, et. al. January 2005
The ASCE Standardized Reference Evapotranspiration Equation
ASCE-EWRI Task Committee Report
ASCE-EWRI Task Committee Report Appendixes A-C

When setting up a system to make an Evapotranspiration measurement, you'll typically first create Average measurements for each of the ET inputs. You'll then create the Evapotranspiration measurement, selecting the corresponding averaged output for each of the Reference inputs.

This measurement has the following properties:

Time

Define when the measurement task runs. The evapotranspiration measurement type always runs daily, i.e., every 24 hours. Time allows you to specify when the final result is logged. For example, when Time is 06:00:00, the final result is logged at 6am.

TempUnits

Specify the units of the air temperature measurement input ("AT"). Choices are Fahrenheit or Celsius. Be sure you configure the AT input to produce an air temp result in the selected units, otherwise the ET result won't be correct.

BPUnits

Specify the units of the barometric pressure measurement input ("BP"). Choices are in-

Hg or mb. Be sure you configure the BP input to produce a result in the selected units, otherwise the ET result won't be correct.

SolarUnits

Specify the units of the solar measurement input ("Solar"). Choices are Ly or W/m2. Be sure you configure the Solar input to produce a result in the selected units, otherwise the ET result won't be correct.

WindUnits

Specify the units of the wind speed measurement input ("WS"). Choices are ft/sec, km/hr. knot, mph. or m/s. Be sure you configure the wind speed input to produce a result in the selected units, otherwise the ET result won't be correct.

ETUnits

Specify the units of the evapotranspiration calculated output. Choices are cm, in. or mm.

ETType

Specify the type of evapotranspiration calculation to make. Choices are ETo (Standardized Reference Evapotranspiration, short grass), ETr (Standardized Reference Evapotranspiration, tall alfalfa), or ETWater (Same as ETo except uses albedo of 0.06, characteristic of open water).

WindElevation

Elevation in meters at which wind measurements are taken.

Input Type (AT, BP, RH, Solar, and WS)

Each input has an InputType property and associated fields for configuring how to make the corresponding measurement. When creating the ET measurement for the first time, the system prompts you to create and configure inputs for each of the input types.

Since the inputs are expected to be averaged, you will typically use the Reference input type to select an averaged output you've already set up.

Property Changes

When making changes to an evapotranspiration measurement property, you may be prompted, "Reset ET data?" Press SET/YES to have the final result computed using samples taken only from the point of reset on. Press CANCEL/NO to have the final result computed using the samples taken so far, as well as those to come (if you've made changes to a property that will cause samples so far taken to be invalid, then select SET/YES).

Calculation Technique

The calculation technique is based, in part, on an example presented at the New Mexico Climate Center web site:

http://weather.nmsu.edu/math/penmans.html

The web site provides a link to an Excel spreadsheet with the example.

The ASCE Task Committee reports are available at:

http://www.irrisoft.net/downloads/literature/ASCE%20Standardized%20Equation%20Jan%2020

05%20Apendix%20A.pdf

http://www.irrisoft.net/downloads/literature/ASCE%20Standardized%20Equation%20Jan%202005.pdf

Inclinometer

This measurement type supports Slope Indicator's (Durham Geo-Enterprises's) Vertical In-Place Inclinometers.

This measurement takes three voltage inputs, AxisA,AxisB, and TempC. The measurement produces three outputs, AxisA temperature compensated tilt, AxisB temperature compensated tilt, and TempC in Celsius.

The setup of this measurement type differs based on whether the sensor's cal sheet lists a calibration factor named "TOFF". If the cal sheet for your sensor lists a TOFF property, be sure to set "HasTOFF" (below) to Yes.

This measurement has the following properties:

Interval, Time

Define when the measurement task runs. (See details under Instantaneous)

HasTOFF

If the calibration sheet for your sensor lists a TOFF parameter, set this property to Yes. Otherwise, set it to No.

TOFF

This property is displayed only when HasTOFF is Yes. Enter the value of TOFF from the sensor's cal sheet.

AC3, AC2, AC1, AC0, AS2, AS1, AS0, AF1, AF0

These properties are coefficients for AxisA, and are displayed only when HasTOFF is Yes. Enter the values from the sensor's cal sheet.

BC3, BC2, BC1, BC0, BS2, BS1, BS0, BF1, BF0

These properties are coefficients for AxisB, and are displayed only when HasTOFF is Yes. Enter the values from the sensor's cal sheet.

C0_A, C1_A, C2_A, C3_A, T0_A, T1_A

These properties are coefficients for AxisA, and are displayed only when HasTOFF is No. Enter the values from the sensor's cal sheet.

C0_B, C1_B, C2_B, C3_B, T0_B, T1_B

These properties are coefficients for AxisB, and are displayed only when HasTOFF is Yes. Enter the values from the sensor's cal sheet.

Input Type (AxisA)

Specifies the input type to use for the AxisA parameter of the tilt calculation. This input type is typically set to Voltage.

Input Type (AxisB)

Specifies the input type to use for the AxisB parameter of the tilt calculation. This input

type is typically set to Voltage.

Input Type (TempC)

Specifies the input type to use for the computing the TempC temperature output, in Celsius. This input type is typically set to Voltage, and comes by default with a 5th order polynomial defined to convert the voltage input to Celsius.

MBOut

The MBOut measurement type is used to write one or more registers in a target modbus slave device. Communication over serial and TCP/IP are both supported.

MBOut normally takes the current input value and writes it into one or more registers in the target device. However, when the ExtendedWrite property is set to "Yes", you can use MBOut to write a complete set of local registers into a mirror set of registers in the target device, using a single modbus communication.

This measurement has the following properties:

Interval, Time

Define when the measurement task runs. (See details under Instantaneous)

DeviceID

The Device ID of the target device.

Note: when using a device type of TCP/IP (i.e., ModbusTCP), the DeviceID field is typically irrelevant. However, some ModbusTCP devices are known to require a value of either 0 or 255. Hence, if the device appears not to respond when using the default DeviceID of 1, try either 0 or 255. In addition, when using a serial bridge, DeviceID is often used to specify the address of the destination device on the serial bus.

TargetRegister

The register to be written in the target device. When ValueType is float, int, or uint (i.e., two consecutive registers are to be written), TargetRegister defines the base register (lower) of the two. Note: in the 8310, modbus register nunbers always start at 1 (not 0).

ValueType

Specifies the type of value to write in the target device. Possible values are:

float	32 bit floating point, uses two consecutive registers
int	signed 32 bit integer, uses two consecutive registers
uint	unsigned 32 bit integer, uses two consecutive registers
short	signed 16 bit integer, uses one register
ushort	unsigned 16 bit integer, uses one register

MSW

For multi-register value types (int, uint, and float), determines which register is assumed to contain the most significant word (MSW) of the value. When set to "Low Reg", the lower register of the register pair is assumed to contain the MSW.

ExtendedWrite

ExtendedWrite defaults to "No". When set to "No", the measurement simply takes the value of the input and writes it to the register (or register pair, if int, uint, or float), in the target device defined by the TargetRegister property.

When ExtendedWrite is set to "Yes", the system reads the values of multiple consecutive **local** registers and writes those values into a consecutive register set in the target device, all in a single modbus communication. The measurement does not provide settings for an input reading when ExtendedWrite is "No", since no input reading is used.

LocalBaseRegister

This property is visible only when ExtendedWrite is "Yes", and specifies the local base register starting the consecutive set of registers to write into the target device. Note: in the 8310, modbus register nunbers always start at 1 (not 0).

NumRegisters

This property is visible only when ExtendedWrite is "Yes", and specifies the number of registers to read locally and write into the target device.

MBDeviceType

Defines the type of communication used to talk to the target device. Possible values are Serial and TCP/IP. When "Serial", you also need to select the COMPort configured for Modbus communications.

COMPort

This property is visible only when MBDeviceType is set to "Serial". Use this property to select the COM port configured fro Modbus communications. NOTE: you must configure the COM port for Modbus using the Station Setup – Communications menu.

TCP/IP Settings

These settings are visible only when MBDeviceType is set to "Tcp".

IPAddress	The TCP/IP address of the target device
IPPort	The IP Port to use when connecting to the target device
EnableLAN	Enable (turn on) LAN to ensure LAN interface is used for transactions (as opposed to GPRS or other TCP/IP interface that might be available; NOTE: the LAN when on, is always favored)

Timeout

Specifies the time in milliseconds to wait for a response from the target device

Retries

Specifies the number of times to retry a request on failure

SendTime

The SendTime measurement type is special, in that it doesn't actually measure anything. As

such, this measurement type has no inputs or outputs. The purpose of the SendTime measurement type is to synchronize the time of another station to the current station's system time. The Interval and Time properties determine when the synchronization occurs (just as they determine when to measure for other measurement types).

When the time specified by the *Interval* and *Time* properties is reached, the time of the current system is sent to the system designated by the "PathURL" property, using an SSP "set-time" message.

To use the SendTime measurement type, you need to have a communications link between the current station and the station you want to synchronize. This link can be a direct link over RS232, TCP/IP, or over line-of-sight radio. In other words, the following communications device types that you can set up under the Communications menu are supported: DIRECT, RADIO, SSP, and LAN.

DevicePort

Use DevicePort to select the communications device to use to send the synchronization message. Only DIRECT, RADIO, SSP, and TCP/IP device types will be shown as selectable device types. The system always has a TCP/IP device type (the LAN is always "installed"). However, the other device types will only show up once you have set them up on the Communications menu.

PathURL

This property specifies which station will be synchronized. To broadcast the set time message to all listeners, set the PathURL property to "*". Otherwise, enter a specific station name or station path (e.g., \patha\pathb\stationx). When the DevicePort selection is TCP/IP, enter the URL to the target station.

IPPort

If TCP/IP is the current device type, then the IPPort property is displayed. This property allows you to specify the IP port of the target station. This should typically be left to 23 (telnet).

UserName

If TCP/IP is the current device type, then the UserName property is displayed. This property allows you to specify the user name to use when logging in to the target station, before the set-time message is sent.

Password

If TCP/IP is the current device type, then the Password property is displayed. This property allows you to specify the password to use when logging in to the target station, before the set-time message is sent.

Vibrating Wire

This measurement takes three inputs, two of which are optional: frequency (Freq), temperature (TempC), and barometric pressure (BP). The frequency input is not optional, and is the measured frequency of the sensor, in units of either Hz or Digits. Temperature and barometric pressure are optional and, when present, are used to compensate the frequency measurement for those factors. Temperature is expected to be in Celsius, and is typically provided by most vibrating wire sensors in addition to frequency. Barometric pressure typically comes from a

reference to another system measurement.

The measurement produces four outputs: 1) the phenomena being measured ("Out"), 2) the input frequency in Digits ("Digits"), 3) temperature (if measured, "TempC"), and 4) the input frequency in Hz ("Freq").

This measurement has the following properties:

Interval, Time

Define when the measurement task runs. (See details under Instantaneous)

FreqInputUnits

Specifies the units of the frequency (Freq) input. May be either Digits or Hz.

TempCompensation

When Yes, the TempC input is measured, and is used to compensate the calculation of Out. The measured temperature is output in the TempC output.

BPCompensation

When Yes, the BP input is measured, and is used to compensate the calculation of Out.

CalibrationUnits

Specifies the units used on the sensor calibration sheet. May be either Digits or Hz. The units selected help determine which calibration factors are presented for edit.

A, B, C

These values come directly off the sensor's cal sheet. These factors are available when calibration units are Digits, or when the calibration units are Hz and temperature compensation is disabled.

K, T0

These values come directly off the sensor's cal sheet. These factors are available when calibration units are in Digits, and temperature compensation is enabled.

C0, C1, C2, C3, C4, C5

These values come directly off the sensor's cal sheet. These factors are available when calibration units are Hz and temperature compensation is enabled.

S0

This value comes directly off the sensor's cal sheet, and is available only when BPCompensation is enabled. Enter a value in a consistent set of units as the measured barometric pressure.

PressureScale

This value is available only when BPCompensation is enabled. It is used to convert from the barometric input units to the units that the output is in.

Note: For vented sensors, barometric pressure will not be included. For very high pressure sensors, barometric pressure will unusally not be included since its effect becomes insignificant.

Here are some hints as to how to set the value of PressureScale (note: S is the measured barometric input):

1. If both S and S0 are in mB or hPa and the calibration coefficients are for PSI, the value of ps would be 0.014504
2. If both S and S0 are in mB or hPa and the calibration coefficients are for kPa, the value of ps would be 0.1
3. If both S and S0 are in mB or hPa and the calibration coefficients are for MPa, the value of ps would be 0.0001

Freq InputType

Specifies the input type to use when measuring the frequency input.

TempC InputType

Specifies the input type to use when measuring the temperature input. The input is expected to be in Celsius. The processing on the input may be used to convert to Celsius, if needed. Note: this InputType property, and the associated properties used to configure the input, are only available when TempCompensation is Yes.

BP InputType

Specifies the input type to use when measuring the barometric pressue input. The input is expected to be in the same units as S0. The processing on the input may be used to convert, if needed. Note: this InputType property, and the associated properties used to configure the input, are only available when BPCompensation is Yes.

InputType

Description: Each Measurement generally requires one or more inputs for the measurement. Each input is identified by the measurement number and input number (such as M1.I1).

The 8310 has a powerful set of built-in input types that allow measurement of most common hydrologic and meteorological sensors. You can also define your own custom input function by writing a basic program whose name starts with "INPUT_". See Chapter10 for more information about inputs defined by a basic program.

The different built-in input types are described below:

Voltage

Voltage inputs connect to the analog inputs of the 8310 (Terminal Strip B). The Voltage input type can make both single ended and differential measurements.

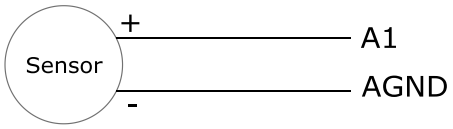


Figure 2 Single Ended Voltage Measurement

The full scale voltage for the measurement is selectable as 0-5 (+/-2.5 for differential) or 78mv. The following user settings are available:

Switched Power	Specify desired switched power for the input. Note that this is separate from VREF that is turned on for all voltage measurements.
Module	I/O module number (the built-in analog module is module 1)
Channel	Channel number where sensor is connected. Note: if you select differential below, you will connect to a pair of channels (1:2, 3:4, 5:6, or 7:8). Specify the channel number of the positive output. Typically the positive output will be connected to the odd channel of the pair (e.g. 1, 3, 5)
Differential	YES | NO
FullScale	0-5V/+2.5V | 78mV (2.5 is the fullscale for a differential input.)
Settling Time	Milliseconds, time to wait after VREF is turned on before making the measurement. See description below.
FilterNotch	Hz (default 60) See description below

Using Differential

Differential measurements allow measuring inputs that are not referenced to ground or are across a device. Differential measurements are bipolar in that the positive input can be either above or below the negative input in voltage. Even though the differential measurement is bipolar, each input is still limited to a -0.1V to 5V range with respect to the 8310's power supply ground. Differential measurements tend to be slightly more accurate than single ended since the measurement reference point can be precisely defined. In the example below, the channel would be specified as 2 since the sensor positive output is connected to A2.

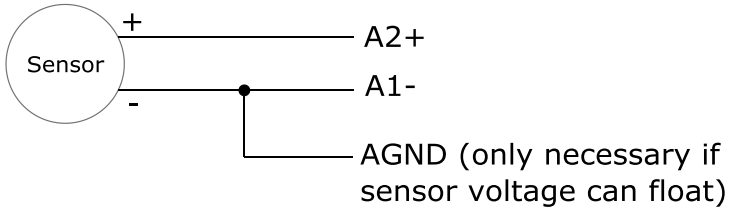


Figure 3 Differential Voltage Measurement

Using FullScale

When using the 0-5V/+2.5V scale, the resolution of the built in analog module is 76 micro-volts. When measuring a device whose output is less than 78mV, a 2 micro-volt resolution can be achieved by using the 78mV scale.

Using Settling Time

The settling time parameter allows the 8310 to accommodate slow responding sensors that require a period of time to establish their proper output before being measured. This could be due to a required warm up time, or it may be due to the sensor having a high impedance output and trying to charge the cable capacitance of a long cable. For

devices that are always powered on, the settling time can be reduced in order to speed the measurement and increase the measurement throughput.

Note: when sensors are muxed, the AIO module isn't aware of when sensors are actully "muxed-in". Hence, you may need to set the mux settling time to wait additional time after each channel is muxed in, in order to ensure the desired settling time wait is satisfied.

Using FilterNotch

The filter notch parameter provides a means to adjust the conversion time to reject noise that may be coupled onto the DC input signal. The default is 60Hz to reject the AC power line frequency. In countries where the AC power line frequency is 50Hz, it is recommended that 50 used. Typical conversion time for the built in analog module with a 60Hz notch is 100mS plus the settling time.

Bridge

Bridge inputs are a special class of voltage measurements for ratiometric type sensors where the output is dependent upon the supply voltage and where they will be powered off of Vref. Using Bridge input type will provide slightly greater accuracy than Voltage in that the measurement will take into account any deviation of Vref from its nominal value.

The Bridge input type uses the same settings as the voltage input type. Additional measurements are made of VREF and the result is expressed as a ratio of the input to VREF on a scale from 0 to 1.

Note: When specifying the input channel for a differential bridge measurement, be sure to set the channel to the channel connected to the positive lead.

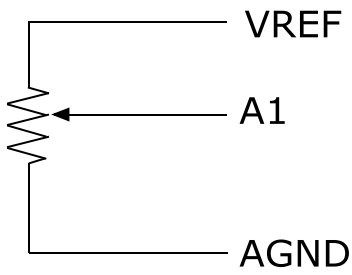


Figure 4 Single ended Bridge Measurement

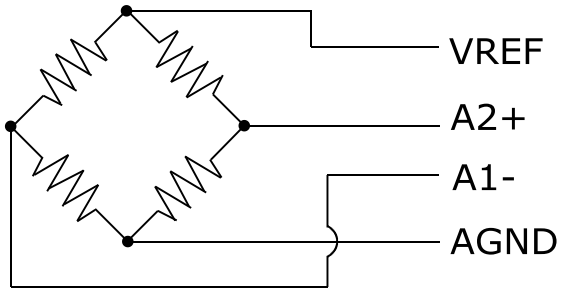


Figure 5 Differential Bridge

VexciteSense

HasVexciteSense property should be set to true when measuring either 4/5 wire potentiometer inputs, or 5/6 wire bridges. Set the VexciteSenseChannel property to the sense channel (e.g., A2 and A3+ in the figures, below).

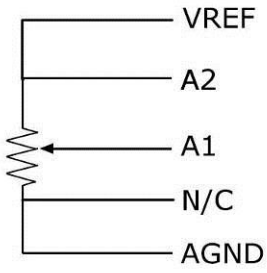


Figure 6 Single ended 4/5 wire potentiometer

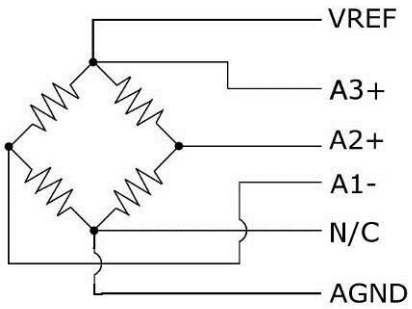


Figure 7 Differential 5/6 wire bridge

Resistance

The *Resistance* input type is used for thermistors and other resistance devices where you want to know the actual resistance of the device (rather than a voltage derived from the excitation voltage). This resistance can then be converted into engineering units using one of the processing types provided.

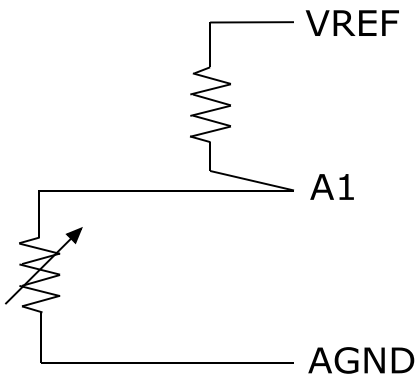


Figure 8 Resistance, single ended

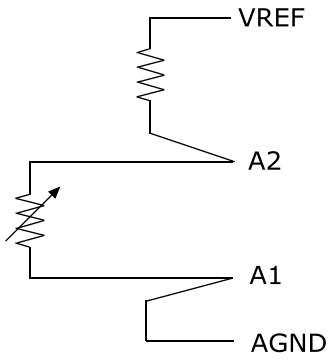


Figure 9 Resistance, Differential

The settings for resistance inputs are the same as voltage with the added setting of a reference resistance. The reference resistor is connected as shown in the figure below. The resultant resistance is only as accurate as the reference resistor. For the most accurate measurements, use a resistor with low temperature sensitivity and high accuracy (e.g. VISHAY, S102C 10K000, 10K 0.01% resistor)

4-20mA

The *4-20mA* input type simplifies the task of making the measurement of a 4-20mA sensor with the output value having the units of mA prior to any processing. The settings for the 4-20mA input type are the same as voltage, with the addition of a reference resistor. The resultant measurement is only as accurate as the reference resistor. For the most accurate measurements, use a resistor with low temperature sensitivity and high accuracy. For channels 1 & 2 the 8310 includes built in, temperature stable, highly accurate, 100 ohm resistors that are automatically switched in during the measurement. Note, that most 4-20mA sensors require a second or more to warmup so be sure to set the settling time (or warmup) to the value recommended by the manufacturer. If the sensor needs to be continuously powered, then change the appropriate jumper (AN1 or AN2) on the termination board to place the analog input into current "I" mode which leaves the 100 ohm resistor always connected between the input and ground. See Figure 14 - J9 - AN1 and AN2 input mode jumpers in the 8310-N Protection/Termination Module Jumpers section for further details.

The overall range for the measurement is 0 to 22ma. However, any value < 3.8 or >21 will be marked as BAD.

When using channels 1 and 2, the system uses an internal load resistor and switches it on/off allowing you to wire to PROT+12 rather than SW12.

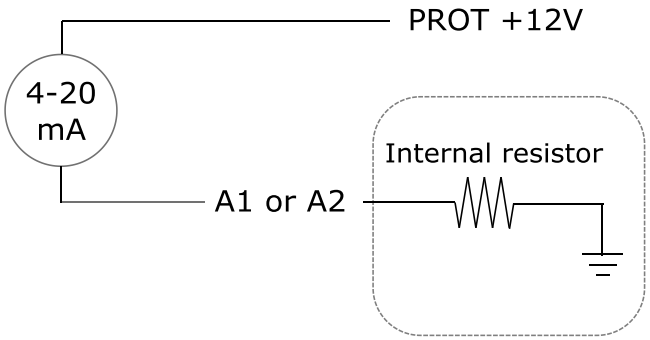


Figure 10 4-20ma using A1 or A2

When providing your own load resistor, never use a value more than 100 ohms, and wire the sensor to SW-12 to conserve power.

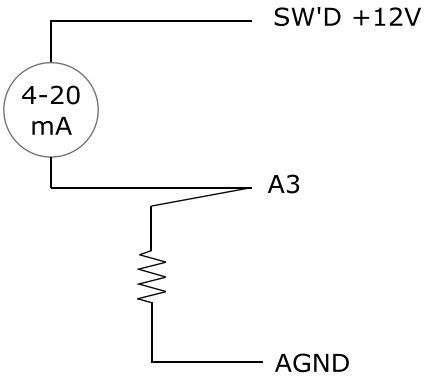


Figure 11 4-20ma using External Load Resistor

SDI

SDI inputs utilize the SDI-12 interface on the 8310. The SDI InputType requires several properties to be configured:

SDIAddress	0-9,A-Z,a-z
SDICommmand	M,C,MC,CC,…
SDIParam	0..99

Solar

The Solar input type measures the voltage of the solar input. The measurement of the solar input can be used to track the health of secondary power.

Reference

Reference inputs access data from other measurements. This allows for multi-level processing on any output – such as an average of an average. The only configuration value for a reference input is the selection of the measurement output you wish to use.

QuadSE

QUADSE inputs are special digital inputs compatible with quadrature shaft encoders. They require the following values:

Module	1
Channel	1
Circumference	Foot | Half-Meter | Other OtherCircumference
CountsPerTurn	100 | 254 | 246| 400 | 800
ClockWiseRotation	Yes | No
QuadSEUnits	Feet | Meters

The 8310 I/O module is capable of tracking quadrature changes at a rate of 4KHz. This translates into rotational speeds of 160 revolutions per second for a 100 count/revolution encoder or 40 revolutions/second for a 400 count/revolution encoder.

InternalTemp

This input type reads the internal temperature sensor of the 8310. This sensor is located on the microprocessor board and is accurate to +/-1 C. Note that because of heat generated by the electronics, this temperature may be higher than the environment around it. The only user setting for this type is the TempUnits: Celsius or Fahrenheit.

Frequency

Frequency inputs are measured by the Digital I/O module. The Frequency input type allows for the following user settings:

Module	1
Channel	1
PeriodMS	200

The maximum input frequency is 8kHz when all channels are changing. If only one, then the limit is higher. The minimum frequency depends on the Period selected with FMIN = 1000/PeriodMS. For example, with PeriodMS of 200, the minimum frequency would be 1000/200=5Hz.

Note: the 8310 does not support low level frequency inputs. The voltage level of the input must be at least 2.0 volts to be seen as a high and it must be less than 0.5 volts to be seen as a low.

The system measures the number of pulses it sees between successive measurements to compute the frequency, as long as the last measurement occurred within about one quarter of the period of when it was supposed to. If the last measurement occurred outside of that window (or hasn't yet occurred), then two readings are taken.

Counter

Counter inputs are measured by the Digital I/O module. The Counter input type allows for the following user settings:

Module	1
Channel	1
ResetCount	YES | NO
FilterValue	0
UpdateOnChange	YES | NO

ResetCount instructs the 8310 to reset the counter each time a measurement is made. The default setting for *ResetCount* is NO, meaning that the counter will not be reset with each measurement but will keep going up as an accumulator or totalizer. The counter is 32 bits and will eventually roll over at 2^32 counts. Any calibration of a counter sensor will reset the accumulator to go up 2^32 counts from the calibration point.

Some instruments do not have a clean output signal and the 8310 may make a measurement and detect 2 or 3 counts where only one count was generated. When this happens, you can use FIlterValue to help eliminate the erroneous counts. Most mechanical switches, like a tipping bucket output, have a switch bounce, so a filter should be used to eliminate false counts. A value of 0 specifies no debouncing while a value of 1 to 255 requires the input to remain in each state for filter_value*0.5ms in order for the system to register a count.

A good rule of thumb for selecting the filter value is to set it to the width in milliseconds of the narrowest pulse to be measured. This assumes that the switch bounce period is less than half the active period. Filter does limit the maximum frequency that can be reliably measured as follows:

FilterValue	Max Frequency	Pulse Period (ms)
0	8KHz	--
1	1 KHz	1
2	500 Hz	2
3	333 Hz	3
255	0.4Hz	255

Frequency of a square wave = 1/(FilterValue*2*.0005)

All counter inputs include a 100K pullup to +5V.

UpdateOnChange: when "Yes", the measurement will execute when the counter input changes. This measurement occurs in addition to the defined schedule.

Constant

Constant input types are primarily used for testing.

ConstValue	0
TestMode	Yes | No

When *TestMode*=No, the value of *ConstValue* is output. When *TestMode*=YES, the system provides data according the value of *ConstValue*:

CONSTANT	OUTPUT
1	TickCount (ticks have units of milliseconds, not synronized to any particular time)

2	Random Number between 0 and 1. Use Slope and offset to get other values (e.g. a slope of 100 and an offset of 0 would return values from 0 to 100).
3	Output Increases by 1
4	Output Increases by 1 and delay 500mS

BinIN

BinIN (binary) inputs are measured by the Digital I/O module. The *BinIN* input type allows for the following user settings:

Module	1
Channel	
Invert	YES | NO
FilterValue	0
UpdateOnChange	YES | NO

The normal sense of the *BinIN* is:

0 volts=0

>2.5 volts=1

When invert is YES, the sense is reversed:

0 volts=1

>2.5 volts=0

UpdateOnChange: when "Yes", the measurement will execute when the input changes. This measurement occurs in addition to the defined schedule.

Battery

Battery is the main power connection of the 8310. The measurement of the battery input can be used to track the health of the main power. Note that it is common for the battery voltage to change throughout the day and night when using a solar panel to charge the battery. The battery voltage can also change depending on what other devices are turned on at the time the measurement is made.

GetTag

The GetTag input retrieves the value of a system "tag", and uses that as the input to the measurement. The "tag" may be a local value, or a remote value. If the value is remote, the remote station is contacted over a communications port in order to retrieve the value of the tag.

Tags that are local to the system include tags created in basic programs using the *Declare Tag* statement, as well as the measurement outputs.

To use the GetTag input type for remote tags, you need to have a communications link between

the current station and the station you want to synchronize. This link can be a direct link over RS232, TCP/IP, or over line-of-sight radio. In other words, the following communications device types that you can set up under the Communications menu are supported: DIRECT, RADIO, SSP, and TCP/IP.

TagName

Specify the name of the tag to retrieve. When the tag refers to a Tag created in a basic program, use the same name you used in the Declare Tag statement. When the tag refers to a measurment output, use the name of the output.

DevicePort

Use DevicePort to select the communications device to use to retrieve the tag. Only NONE, DIRECT, RADIO, SSP, and TCP/IP device types will be shown as selectable device types. The system always has a TCP/IP device type (the LAN is always "installed"). However, the other device types will only show up once you have set them up on the Communications menu.

Specify a device type of NONE when the tag is local.

PathURL

This property specifies the path to the station containing the tag. The path can be a simple station name, or a station with full path information included (such as \patha\pathb\stationx). When the DevicePort selection is TCP/IP, enter the URL to the target station.

IPPort

If TCP/IP is the current device type, then the IPPort property is displayed. This property allows you to specify the IP port of the target station. This should typically be left to 23 (telnet).

UserName

If TCP/IP is the current device type, then the UserName property is displayed. This property allows you to specify the user name to use when logging in to the target station, before the set-time message is sent.

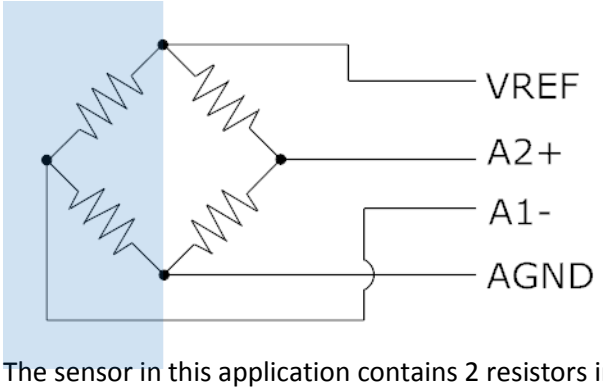
Password

If TCP/IP is the current device type, then the Password property is displayed. This property allows you to specify the password to use when logging in to the target station, before the get tag message is sent.

DiffResistance (Differential Resistance)

This input type is used to measure Differential Resistance sensors, such as those made by Carlson Concrete Instruments for Dam Safety and concrete structure monitoring applications, where stresses and strains on the structure are monitored and recorded, and is typically used in combination with the Differential Resistance measurement type.

This measurement requires a special add-on board to aid in the precision measurement of the analog inputs by the 8310. Please contact Sutron customer service for more information on obtaining board.



The sensor in this application contains 2 resistors in series, forming one half of a wheatstone bridge. The add-on board forms the other, reference side of the bridge circuit.

This input type is capable of producing one of two different outputs, either "R1/R2", or "R1+R2", as selected in the DiffResParam property. The ratio R1/R2 gives an indication of strain, while R1+R2 can be used to determine temperature of the probe.

This input type is typically used with the Differential Resistance measurement type, to take R1+R2 and R1/R2 and translate them into a measurement of stress/strain, displacement, and temperature.

MBSensor

The MBSensor input implements a Modbus Master for reading a Modbus sensor. Both serial and TCP/IP are supported.

DeviceID

Specifies the Device ID of the modbus slave from which to read the value.

Note: when using a device type of TCP/IP (i.e., ModbusTCP), the DeviceID field is typically irrelevant. However, some ModbusTCP devices are known to require a value of either 0 or 255. Hence, if the device appears not to respond when using the default DeviceID of 1, try either 0 or 255. In addition, when using a serial bridge, DeviceID is often used to specify the address of the destination device on the serial bus.

TargetRegister

Specifies the base register number to read from the target device. Note: in the 8310, modbus register nunbers always start at 1 (not 0).

ValueType

Specifies the type of value to read from target device. Possible values are:

float	32 bit floating point, uses two consecutive registers
int	signed 32 bit integer, uses two consecutive registers
uint	unsigned 32 bit integer, uses two consecutive registers
short	signed 16 bit integer, uses one register
ushort	unsigned 16 bit integer, uses one register

MSW

For multi-register value types (int, uint, and float), determines which register is used to

contain the most significant word (MSW) of the value. When set to "Low Reg", the lower register of the register pair is used to contain the MSW.

RegisterType

The RegisterType property identifies the type of register to read from the target device. The possible selections are: Input Register, Holding Register, Discrete Input, and Coil.

ExtendedRead

ExtendedRead makes it possible for the 8310 to read multiple consecutive registers from a target device efficiently. When ExtendedRead is "Yes", the 8310 will read multiple consecutive registers in a single operation, and store the results in cache. Only the designated TargetRegister value is output for the current input, but other MBSensor inputs defined in the setup can retrieve values from the cache, rather than repeat the register read from the target device.

MBSensor inputs will use a shared cache whenever the following properties are identical across the MBSensor configurations: DeviceID, RegisterType, BaseRegister, NumRegisters, and DeviceType as well as either COMPort or IPPort and IPAddress, depending on the selected DeviceType.

BaseRegister

The BaseRegister property is avaialble only when ExtendedRead is "Yes". The property specifies the base register of the register set to read from the target device. Note: in the 8310, modbus register nunbers always start at 1 (not 0).

NumRegisters

The NumRegisters property is avaialble only when ExtendedRead is "Yes". The property specifies the number of consecutive registers to read from the target device.

MBDeviceType

Defines the type of communication used to talk to the target device. Possible values are Serial and TCP/IP. When "Serial", you also need to select the COMPort configured for Modbus communications.

COMPort

This property is visible only when MBDeviceType is set to "Serial". Use this property to select the COM port configured fro Modbus communications. NOTE: you must configure the COM port for Modbus using the Station Setup – Communications menu.

TCP/IP Settings

These settings are visible only when MBDeviceType is set to "Tcp".

IPAddress	The TCP/IP address of the target device
IPPort	The IP Port to use in TCP/IP communications with the target device
EnableLAN	Enable (turn on) LAN to ensure LAN interface is used for transactions (as opposed to GPRS or other TCP/IP interface that might be available; NOTE: the LAN when on, is always favored)

Timeout

Specifies the time in milliseconds to wait for a response from the target device

Retries

Specifies the number of times to retry a request on failure

PB200

The Airmar PB200/200WX sensor measures (or calculates) several meteorological parameters, including wind speed, wind direction, barometric pressure, air temperature, relative humidity, and dew point, as well as GPS position (LAT/LON) and UTC time. The 8310 "PB200" input type enables you to read these parameters into the 8310 for further processing and/or logging. The following sections describe how to wire and configure the sensor for use with the 8310.

Wiring

Connect the PB200/200WX sensors to an RS232 or RS485 serial port. Connect the sensor as shown in the table, below.

PB200 Pin #	PB200 Pin Name	Wire Color	RS485 Connection	RS232 Connection
1	V+	Red	V+	V+
2	V-	Black	V-	V-
3	A/+ OUT	White	RS485A	Tx
7	A/+ IN	Yellow	RS485A	Rx
8	B/- IN	Orange	RS485B	N/C
9	B/- OUT	Blue	RS485B	N/C

COMPort and RS485

Use the COMPort property to select the port on which you've connected the PB200/200WX sensor. If you've connected the sensor to an RS485 port, then check the RS485 option (note, COM4 may be configured to either RS232 or RS485 on the 8310, but RS232 only on 7310).

PB200Param

Use this property to select which PB200 parameter you'd like to measure. The available parameters and associated units are:

Name	Description	Units
Dir	Wind direction	degrees True
Speed	Wind speed	m/s
BP	Barometric Pressure	bar
AT	Air Temperature	C
RH	Relative Humidity	%
DewPoint	Dew Point	C
LAT	Latitude	Nearest .0001 minute
LON	Longitude	Nearest .0001 minute

SyncToGPSTime

This property determines whether the PB200 block should set the 8310 system time to the UTC time obtained from the PB200/200WX sensor.

SwitchedPwr

Since the PB200 typically takes several seconds following power-up to produce data, the sensor should either be connected to constant 12V, or should be connected to SW-12 with a suitable Warmup property. When using SW-12, be use the SwitchedPwr Warmup property to define how long to wait before attempting to read data from the sensor after it is first powered on. Increase this value until the 8310 no longer consistently logs this sensor's data with BAD quality following sensor power-on.

PR

This input type was created to support a custom application. It is simply a muxed 4-20ma measurement with defaults of AIO module 1, channel 1, slope-offset processing step, SW-12 warmup of 300ms on DIO module 1, settling time 1000, and filter notch 50. Unless these defaults happen to match your needs, use the analog 4-20ma input type when 4-20ma measurement is needed.

PT

This input type was created to support a custom application. It is essentially a muxed 4-wire bridge measurement with channel selections and other properties fixed based on mux selection. Unless these defaults happen to match your needs, use the analog bridge input type when bridge measurement is needed.

Mux

Every measurement input has the capability of being "muxed", i.e., where the multiple inputs of the same type connect into a mux device that selects only one of the inputs at a time for measure. For example, perhaps you have multiple vibrating wire sensors connected to a mux in a Dam Safety application.

The 8310 supports muxes that are enabled by raising a digital "enable" line, and whose channels are selected through sequential 1 clock per channel pulses of a digital "clock" line.

By default, the Mux property is set to "None", meaning the input is not muxed. To enable muxing of an input, press Right with Mux selected to enter the Mux details menu. Then with the Mux Name property highlighted, press Set (or Enter), to change the Mux Name property to the name of the mux you'd like to use. To create a new mux, select "MuxA <new>" to define a new mux (if other muxes are already defined, the prompt may be for "MuxB <new>", or "MuxC <new>", etc.).

MuxChannel

When the Mux property is set to something other than "None", the MuxChannel property is displayed and should be set to the channel to select (i.e., "clock-in"), when it is time to measure the input.

Mux Details Menu

When the Mux property is set to something other than "None", you can change the following mux properties from the details menu:

Name

This is the name of the mux selected for the input, or None. You can create new muxes from this menu by selecting the "MuxX <new>" option (where X may be A, B, C, etc.).

DIOModule

When multiple DIO modules are connected to the 8310, use this property to select which DIO module was used when connecting the mux Enable and Clock lines.

EnableChannel

The DIO channel to assert to enable the mux.

ClockChannel

The DIO channel to pulse to select (i.e., "clock-in"), a mux channel.

SettlingTimeMS

The time in milliseconds to wait after clocking-in a channel.

SwitchedPwr

SwitchedPwr has the settings of none, SW-5, SW-12 and DigOut. If the setting is something other than "none" the system will request a warmup time. SW-5 and SW-12 refer to the Switched power connections on the C terminal strip. If DigOut is selected, you must specify one of the digital outputs.

Processing

Slope-offset

A user entered *Slope* and *Offset* are used to scale the input value by the following equation:

Result=Slope*input+Offset

Poly

User entered coefficients are used to scale the input value by the following equation:

$Result=K0+K1*input+K2*input^2+K3*input^3+K4*input^4+K5*input^5$

Steinhart-Hart

The Steinhart-Hart equation models the resistance of a device at different temperatures:

T = 1/(a + b*ln(r) +c*(ln(r)^3)) - 273.15

where r is the input resistance in ohms,

T is temperature in deg C

A, B, and C are coefficients which vary depending on the type and model of the thermistor and the range of interest.

Steinhart-Hart coefficients are available from most thermistor manufacturers. Below is a table of Steinhart-hart coefficients for some commonly used thermistors.

Model	A	B	C
5600-0011	0.0009354011	0.0002210605	0.000000127472
5600-0025	1.12610E-03	2.34545E-04	8.63589E-08
5600-0030	1.12610E-03	2.34545E-04	8.63589E-08
YSI44006	0.0010295	0.0002391	1.568E-07
YSI44032	0.0009354011	0.0002210605	0.000000127472
YSI44005	1.40510E-03	2.36900E-04	1.019E-07
YSI44036	1.12610E-03	2.34545E-04	8.63589E-08

You can also compute for yourself the coefficients by utilizing the resistance data from three different temperatures evenly spread across the range of interest. This is a standard calculation and there are several sites on the web that provide such a calculator. One such site is: http://www.thinksrs.com/support/Therm%20Calc/NTCCalibrator/NTCcalculator.htm . This calculator will compute A, B, and C given three resistance temperature pairs.

Lookup

Lookup uses a user seleced table and interpolation method to produce the desired value. The supported interpolation methods are: linear, semilogY, semilogX, loglog.

The table must be generated on a PC (with Notepad, for example) and then uploaded to the 8310. The format of the data is X,Y pairs of data. Files should be created in comma separate format, such as the following example:

10.22, 11.55
12.481, 20.999
15.0, 40.01

The extension of the file should be changed to .tbl before uploading. TIP: In Notepad, save the file with the name in quotes, such as "MyTable.tbl", and it will be saved with a .tbl extension instead of a .txt.

The name of the file with the data is entered in the DataFile field, and it must reside on /flash disk/.

Basic / Custom Processing Steps

Basic is not actually a seleection but includes any step defined by a Basic program. For instance if you were to create a processing step using Basic called Time2 it would appear in the list as Times2. Here's how a Times2 processing step would appear in Basic:

```
REM Times2.bas - accepts a sensor reading
REM input and returns the modified value.
REM
REM Sensor reading fields we can change include:
```

```
REM     .Time, .Name, .Data, .Quality,
REM     .Units, .Alarm, and .Digits
REM
REM All custom processing step functions begin
REM with the prefix "PROC_":
REM
Public Function PROC_Times2(i1)
   REM We want to retain the settings from the input:
   o1 = i1
   REM and just modify the data portion:
   o1.Data = i1.Data * 2.0
   REM When finished processing we must set
   REM the return value of the function:
   PROC_Times2 = o1
End Function
```

Cal Slope/CalOffset

These values are applied to the input value after the selected processing in order to account for field calibration of the value. The calibration process in the 8310 supports both single point and two point calibration. The single point calibration alters *CalOffset* while two point calibrations affect both *CalSlope* and *CalOffset*.

The default values are 1.0 (*CalSlope*) and 0.0 (*CalOffset*) with no affect on the input data.

Since *CalSlope* and *CalOffset* are calibration values, they are meaningful only to the specific sensors attached to the station. Hence, these values do not move from station to station when cloning setup files (i.e., when loading the setup of one station to another). These values are only ever used in the station where the calibration took place. When a calibrated input sensor has been deleted from a setup, the calibration is also deleted.

Mx.Ix

Each measurement input shows up in the menu with its current value (the last measured value). You can force a measurement of the input by pressing ENTER. Pressing RIGHT initiates a Calibration.

Mx.Ox

All the outputs for the measurement are displayed in the setup menu. Pressing SET/ENTER will force a measurement for some types of measurements. The 8310 will not force an average type measurement – these are only made on the user set schedule. A message is displayed if the system cannot force the measurement. Pressing RIGHT brings up a sub menu for the settings of the output. These settings define if the output is displayed, logged, and transmitted. See the following section on the setup of the outputs.

Station Setup/Measurements/Mx/Mx.Ox

Measurement Outputs have their own properties that define whether the data is displayed, logged, transmitted, etc. Measurement Outputs can also have additional processing applied.

Here's an example Measurement Output menu:

```
Name                    Stage
Units                   Ft
RightDigits             2
Processing      ►       None
Display                 Yes
M1.O1: Log      \Flash Disk\data.log
LoggingInterval         00:15:00
RecordID                <None>
Sequence
Format
Add Alarm
Delete Alarm
AlarmDeadband           5
AlarmLogging            InAndOut
IsSSPCurData            Yes
WebDisplay              Yes
MODBUS          ►
Iridium COM2:   ►   Iridium Settings
LAN             ►   LAN Settings
End M1.O1: Stage
```

Name

The name of the output is typically either the same as the Measurement name, or is a derivative thereof. The default name given is typically sufficient for most systems, but you may change the output name here, if desired. Note that all outputs must have unique names.

Units

This menu item lets you assign a string to describe the units of the value – such as ft, m, etc. Units is a pre-defined, editable string. The units.txt contains the pre-defined values that you can select from, and any additions made will be stored in the same file.

RightDigits

Sets precision of value displayed by defining the number of digits to the right of the decimal point (e.g. use rightdigits=2 to display the value as x.xx).

Processing

Additional processing can be performed on the outputs. The processing choices are the same as those for the inputs. Multiple processing steps are supported for the outputs.

See Processing for more information.

Display

Yes | No – determines whether or not the value is displayed in the main menu

Log

Specifies whether or not data should be logged and the name of the log to use. Note that this property is not shown when RecordID has been set to a log record (the log record defines which log to use when logging).

LoggingInterval

The Logging Interval property allows you to select how often the data should be logged. The logging interval defaults to "00:00:00", which means log on every measurement. You can change

the value of the logging interval to a multiple of the measurement interval, to reduce the number of times a measurement is logged. For example, if the measurement interval is "00:15:00" and logging interval is "00:30:00", the measurement is logged every other measurement.

Setting the logging interval to a value greater than the measurement interval allows you to measure data more frequently than you log it, typcially due to a desire to evaluate the data for alarm more frequently than it is logged.

Note that this property is not shown when RecordID has been set to a log record (the log record schedule determines how often to log the data).

LogScheduledTime

The LogScheduledTime property determines what timestamp is applied to the logged data value (when not logged as part of a log record).

When "Yes" (the default), the scheduled time of the data is used as the time-stamp for the log. For example, if the data is scheduled to be measured at 12:00:00, then the timestamp will be "12:00:00". When "No", the actual time the value is determined is used as the timestamp for the log. This can be useful when you want to record the actual time a min or max value of an average is calculated.

However, note there is a danger to logging data with actual time for timestamp. The min and max values of an average are logged only once the average is complete (since they cannot be known until that time). When the actual time of the min and max is used as the data timestamp, values that *precede* the min and max in the log may have timestamps *later* than the min or max. This is known as a log "discontinuity", and can lead to problems in log downloads where the start and end times are specified. One way to eliminate this concern while still using actual timestamps, is to log these values to dedicated logs (e.g., min.log and max.log).

Note that this property is not shown when RecordID has been set to a log record (the log record schedule determines how often to log the data).

RecordID

The RecordID property enables you to define an output as a "field" of a Log Record. Log Records are used to customize the format of your data. You must set one up in Station Setup/Log Records before you can select a RecordID here. See the section Station Setup/Log Records later in this chapter for a full explanation of Log Records. If you have selected a Log Record, you can press right from here to review or modify the properties of that record.

If a valid RecordID is selected, the following properties appear:

Sequence

Specifies the order in which outputs appear in the Log Record.

Format

Scroll through the list to choose the data format you need, or press enter to manually edit the format. You can manually add a character to separate the fields (measurement name, value, quality, units) or rearrange the fields to suit your needs.

Add Alarm, Delete Alarm, AlarmDeadband, etc.

These menu items are used to manage alarm settings for the output. Select Add Alarm to add a *HiLimit*, *LowLimit*, or *HiROC* alarm evaluation. The output data is evaluated for alarm on every new measurement. The *TxAlarmMode* property in the output's telemetry settings is used to control when to transmit data on alarm.

See Station Setup/Measurements/Mx/Mx.Ox/Telemetry Settings and/or Understand Alarms and Alarm Transmissions for more information.

IsSSPCurData

When Yes, the output is included in data reports that are generated for SSP cur data requests, as is typically done when the station is being polled by XConnect and/or Tempest. You should also set it to Yes when you wish to include the output in speech modem phrases – this exposes the telemetry sub-menu where you may define the phrases to be spoken before and after the output's value.

WebDisplay

When Yes, the output is included in the default web page provided by the 8310 over IP port 80.

MODBUS

The output's MODBUS menu contains the following settings, used to define the output as a MODBUS register.

```
BaseRegister          1
Type          Holding Register
ValueType           float
MSW               Low Reg
Min                 0
Max               65535
LiveReading           No
End MODBUS
```

BaseRegister

Specifies the MODBUS register number to associate with this output. The setting is called "base" register, since you may use two consecutive registers to represent the output as a float, or full-size integer. When two consecutive registers are used (i.e., ValueType is either "float" or "int"), then the number specified here is the lowest of the two used, i.e., "base" of the two.

Type

The Type property identifies the type of register to assign to the output. The possible selections are: Input Register, Holding Register, Discrete Input, and Coil.

The Input Register type allows the output to be read over modbus, either as an integral or floating point.

The Holding Register type allows the output to be both read and written over modbus, either as an integral or as a floating point. Writing an output typically only makes sense when the output reflects the value of a Constant type input. When this is the case, writing the holding register will result updating the corresponding input value constant. From the point of the write on, the output will reflect the new value. This can be useful when the output controls processing elsewhere in the system.

The Discrete Input type allows the output to be read as a single discrete value (0 or 1). The result is "1" when the value of the output is not zero, and is read as 0 otherwise.

The Coil type allows the output to be both read and written as a single discrete value (0 or 1).

ValueType

The ValueType property identifies the type of value represented by the register (or register set, as the case may be). The possible selections are:

float 32 bit floating point, uses two consecutive registers

int signed 32 bit integer, uses two consecutive registers

uint unsigned 32 bit integer, uses two consecutive registers

short signed 16 bit integer, uses one register

ushort unsigned 16 bit integer, uses one register

MSW

For multi-register value types (int, uint, and float), this property determines which register is used to contain the most significant word (MSW) of the value. When set to "Low Reg", the lower register of the register pair is used to contain the MSW.

For example, given a Base Register of 1, a Register Type of Input Register, a Value Type of float, and a MSW setting of Low Reg, then a master request for register 1 returns the MSW of the tag‟s value in IEEE 32-bit float format. A request for register 2 in this scenario returns the LSW of the float value.

This item is disabled when the output uses only one register (coil, discrete, ushort, etc.).

Min

For input and holding registers of value type short or ushort, Min and Max are used to scale the output into the integral range 0 – 65535 (the range of the data type used to communicate register data back to the Modbus master device). Typically, you enter into Min the lowest value you expect this block to contain.

Max

For input and holding registers of value type short or ushort, Min and Max are used to scale the output into the integral range 0 – 65535 (the range of the data type used to communicate register data back to the Modbus master device). Typically, you enter into Max the highest value you expect this block to contain.

LiveReading

When "Yes", a "live reading" is performed when a request to read or write the data is received.

Station Setup/Measurements/Mx/Mx.Ox/Telemetry Settings

Every output has a sub-menu for each telemetry device installed. The sub-menu is named after the type of telemetry installed, e.g., "Iridium COM2: Iridium Settings", or "Satlink COM3: Selftimed Settings", etc.

Note: this menu can typically be accessed from the associated communications device submenu named "Select Output Settings". For example, the Satlink Selftimed Settings menu can be accessed via Communications/Satlink/SelfTimed/SelectOutputSettings. Changes can be made from either menu.

Here is a list of telemetry devices that may be installed:

ALERT	High Sierra Electronics Model 3210 ALERT radio
DIRECT	Direct connection over COM port to PC, etc.
GPRS	GPRS modem
IRIDIUM	Iridium modem
MODEM	Sutron voice modem, or other Hayes compatible data modem

RADIO	Radio used for line-of-sight serial communications
RS485	Direct connection over RS485 comm link
SATLINK	Sutron Satlink transmitter
SSP	Direct connection over COM port to XConnect, Tempest, etc.
LAN	LAN connection
VOICE	Sutron voice modem

TxContent, DataInterval, DataTime, NumVals, Sequence

These properties determine what data is included in transmissions, and its sequence in the transmission (if applicable to the selected format). The value of *TxContent* can be *All*, *Individual*, or *Exclude* as described below. To change the setting press SET/ENTER and select the desired value.

TxContent	Property	Description of Property
All		All the data logged for the output since the last transmission will be transmitted
	Sequence	Sequence determines the order of this output in the transmission message.
Individual		Individual values logged for the output since the last transmission will be transmitted.
	DataInterval	the time interval between readings from the 8310 log
	DataTime	the time at which to begin extracting data from the log in order to build a message
	NumVals	No. of data items for each parameter taken from 8310 log and encoded in each self-timed transmission
	Sequence	Sequence determines the order of this output in the transmission message.
Exclude		Do not transmit this output.

Note: When Pseudobinary B (an interleaved format) is the selected format, the user defines a NumVals setting for all outputs in the device Communications menu, and the meaning of the TxContent property on each output changes: A TxContent value of "Last" no longer means just the last value, but the last *NumVals* values. A TxContent value of "All" no longer means all values since last transmission, but all values up to *NumVals*.

TxAlarmMode

The *TxAlarmMode* property is used to control when an alarm transmission occurs. When *TxAlarmMode* is *TxIn*, a transmission occurs when the output enters alarm. When *TxAlarmMode* is *TxInAndOut*, a transmission occurs when the output both enters and exits alarm.

Additional Telemetry Settings

The following sections describe what other settings are available for each of the different possible telemetry device types that support additional settings.

Voice Settings

The following properties are available under the VOICE COMx: Voice Settings menu item for each output in the system.

PrefixPhrase

This phrase is spoken by the speech modem before the value.

SuffixPhrase

This phrase is spoken by the speech modem after the value.

Station Setup/Measurements/ Mx/Simulate

The Simulate menu allows inputs of the measurement to be manually entered and the calculated output values to be observed. This feature will only be displayed for measurements which support live measurements and have outputs.

A typical simulation menu is show below:

```
Simulate M4: F-BP-CZ11
M4.I1: Freq (Raw)                        4.0
M4.I1: Freq                              4.0
M4.I2: TempC (Raw)                       N/A
M4.I2: TempC                              22
M4.I3: BP (Raw)                            0
M4.I3: BP                                  0
M4.O1+: -Out                       14.95   G
M4.O2+: -Digits                     4.0    G
M4.O3+: -TempC                     22.00   G
M4.O4+: -Freq                      63.25   G
End Simulate
```

For each input, both the raw unprocessed value and the post-processed value will be displayed. You may change either by selecting it and pressing SET, and the outputs will automatically start recalculating. While simulation is taking place you will see "+" appear in the output names (as shown in the sample screen). Scheduled measurements will continue to take place normally, and an "*" may appear in one or more of the output names to indicate that one is occurring. Simulation may delay a scheduled measurement but only for the time needed to compute the new outputs.

If you set the raw value of an input, then the post-processed value will be simulated and displayed. If instead you set the post-processed input value, the raw value will display as "N/A", as the input processing cannot be reversed.

Any input values you enter will be remembered until the next reboot.

Station Setup/Communications

The Station Setup/Communications menu shows the communications ports that are in the system. The menu shows the type of communications configured for each device, and the status of each device. Press RIGHT to see and optionally change the detailed settings for each device. Press SET to change the type of device (note: COM1 is always type DIRECT and cannot be changed).

A typical communications menu is shown below:

```
Communications (5)
```

```
COM1: (Standby-On) ►                DIRECT
COM2: (Standby-On) ►                 VOICE
COM3:              ►             NO CONNECT
COM4:              ►             NO CONNECT
LAN   (Standby-On) ►
End Communications
```

LAN Setup

See Station Setup/Communications/LAN Setup

Station Setup/Communications/COMx DIRECT | RADIO | SSP

These are the detailed settings for communications types DIRECT, RADIO and SSP. This menu has the following items:

```
Enabled
BaudRate
MasterID
TXNormalRate
TXAlarmRate
SSP Settings > details
CarrierDelay
ReplyDelay
AckDelay
NumRetries
RetryDelay
```

Enabled

Enabled is set to YES if you want transmission to perform alarm or selftimed transmissions on this COM device. Set Enabled to NO to prevent alarm and selftimed transmissions. Selftimed transmissions may be sent on a periodic interval by specifying TXAlarmRate and/or TXNormalRate.

Outputs must have IsSSPCurData set to Yes for the output to be included in an alarm transmission.

BaudRate

BaudRate specifies the baud rate for the communications port. The typical value for COM1 Baudrate is 115,200 for direct communications. A value of 115,200 can be used with RADIO as long as the radio supports flow control and high baud rates. Otherwise, a speed of 2400 to 9600 should be used as supported by the radio.

MasterID

The *MasterID* is used to name the destination whenever the 8310 makes a transmission on this device. For example, with MasterID set to BASE, the 8310 will format a packet with the destination of BASE when it makes the alarm transmission. The name can be a base station, another field station, or a base station through a field station. MasterID is a global setting.

Examples of MasterID are:

BASE	send data straight to BASE

SiteA/SiteB/BASE	send data to SiteA, repeat to SiteB then to BASE
SiteA/SiteB:COM3/BASE	send data to siteA, repeat through COM3 to SiteB, then to BASE

TXAlarmRate

TXAlarmRate may be used to configure selftimed reporting of alarm data on a periodic basis that take place when the system is in alarm. For example, if you want to have a report from the 8310 every hour when the system is in alarm, you would set TXAlarmRate to 1 hour. Setting *TX Alarm Rate* to 00:00:00 will disable this feature.

Outputs must have IsSSPCurData set to Yes for the output to be included in the alarm transmission.

TXNormalRate

TxNormalRate may be used to configure selftimed reporting of alarm data on a periodic basis that take place when the system is not in alarm. The *TXNormalRate* field contains a *Time* value indicating the amount of Time between transmissions from the 8310 when there are no sensors in the alarm state. For example, if you want to have a report from a group twice per day, set *TXNormalRate* to 12 hours. Setting *TX Normal Rate* to 00:00:00 will disable this feature.

Outputs must have IsSSPCurData set to Yes for the output to be included in the alarm transmission.

Additional settings are available for each device.

SSP Settings/CarrierDelay

Carrier Delay specifies the amount of Time the carrier must be on before the data is sent. The typical value for Carrier Delay is 10, meaning 1.0 seconds. The 8310 will key the transmitter, wait for the carrier delay period and then send data. The *Carrier Delay* affects both internal and external transmitters.

SSP Settings/ReplyDelay

Reply Delay sets the Time that the 8310 will delay before it replies to a message. Its default value is 0, meaning no delay. A value of 10 would cause the 8310 to wait 1 second after receiving a message before transmitting the reply. *ReplyDelay* is useful, if the system sending a request, needs a second or two to get ready for the reply.

SSP Settings ACKDelay

Ack Delay sets the Time that the 8310 will wait for an acknowledgment when sending an SSP message. Many SSP messages expect an acknowledgment from the receiving end to let the sender know the message was received without errors. With *Ack Delay* 100 (the default value), the Ack message must be received in 10 seconds. On radio systems with multiple repeater paths, *Ack Delay* should be much longer (about 10 seconds for each path).

This value is shared by both radio and telephone communications. If you are using both modes, set the value to the longer of the two response times.

SSP Settings NumRetries

See *RetryIn* (above) for a description of how *NumRetries* is used to control the number of re transmissions that are made when a sensor goes into alarm. If *NumRetries* is set to 0, no re transmissions are made. A typical value for *NumRetries* is 3.

SSP Settings RetryDelay

When a sensor goes into alarm, the 8310 will immediately make a transmission. If the ACK is received, the 8310 changes the sensor status to Alarm and will not attempt a retry. If no ACK is received and NumRetries is >0, the 8310 will delay based on *RetryDelay* and then try again. This

continues until the number of attempts > NumRetries.

The 8310 delay is actually a random delay based on *RetryDelay*. With *RetryDelay* set to 00:01:00, the delay will be anywhere from 0 and 60 seconds (00:01:00). Typically, *RetryDelay* is a short Time of less than 10 minutes or so.

Station Setup/Communications/COMx ALERT

This menu provides access to all ALERT settings needed to configure the ALERT modem for transmissions. A typical ALERT Settings menu is shown below followed by a description of all the fields.

```
                ALERT COMx:
Enabled                                    No
TxTime                                 00:00:00
BaudRate                                   1200
Select outputs          ►
End ALERT Menu
```

Enabled
This property must be set to YES to enable ALERT transmissions.

TxTime
This property defines an offset to timed transmissions. When 00:00:00, no offset is applied. Hence, given a timed transmission with interval 01:00:00, if TxTime were 00:15:00, then the timed transmission would occur every hour on the 15 minute mark, i.e., 00:15:00, 01:15:00, 02:15:00, 03:15:00, etc.

BaudRate
The baud rate to use when communicating with the ALERT modem. The default is 1200, which is the baud rate to be used when using the High Sierra ALERT transmitter.

Select Outputs
This menu shows how ALERT settings are configured for each output in the system . Pressing SET/ENTER on one of the values will take you to the ALERT COMx menu for that particular output, where you can configure the output for event and/or timed transmissions, as desired.

Note: this is the same as the ALERT Settings accessed via Measurements/Mx/Ox/ ALERT Settings. Changes can be made from either menu.

Select Outputs/ALERT_ID
This property is a number between 0000 and 8191 that serves as the ID of the sensor on the ALERT network. This number is typically derived from an assigned Station ID plus an offset for the sensor value. For example, given a Station ID of 1620 and a sensor ID of 2, set ALERT ID to 1622.

Select Outputs/TxInterval
The interval for timed transmissions. When set to "00:00:00", timed transmissions do not occur. When set to "01:00:00", the value of the output is transmitted every hour, and so on. Note, the TxTime property of the ALERT communications device setup can be used to apply an offset to the timed transmission.

Select Outputs/TxEvent
Specifies the event that must occur to trigger a non-timed transmission. Values are HiLimit,

LowLimit, HiROC, and Always.

Off: disable event transmissions for this output

- HiLimit: transmit when measured result exceeds Threshold
- LowLimit: transmit when measured result is lower than Threshold
- HiROC: transmit when change in measured result exceeds Threshold
- Always: transmit every time value is measured

When TxEvent is HiROC, the "HiROCInterval" property becomes visible and may be set to either "SinceLastTx" or "SinceLastMeasurement"

Transmit on "tip":
In addition to the events listed above, you can also configure the system make an ALERT transmission on the occurrence of a change to the counter or binary input, i.e.., on the "tip" of a tipping bucket. See the Counter and BinIn input types descriptions of "UpdateOnChange" for more information.

Select Outputs/Threshold
The threshold to use when evaluating a HiLimit, LowLimit, or HiROC transmit condition (see TxEvent, above).

Select Outputs/Override
A special threshold value that will cause a transmission even when the hold-off period has not yet expired.

Select Outputs/Min
Minimum expected sensor value, used in combination with Max to scale value before transmission, enables the system to transmit the maximum precision for the measured value. For example, given a temperature sensor with range -40.0 C to +60.0 C, enter -40.0 for Min and +60.0 for Max. When Min is 0 and Max is 2047, no scaling occurs.

When Min and Max are used, the base station determines the measured value as: x = y(Max - Min) / 2047 + Min, where y is the transmitted value.

Select Outputs/Max
Maximum expected sensor value, used in combination with Max to scale value before transmission, enables the system to transmit the maximum precision for the measured value. For example, given a temperature sensor with range -40.0 C to +60.0 C, enter -40.0 for Min and +60.0 for Max. When Min is 0 and Max is 2047, no scaling occurs.

When Min and Max are used, the base station determines the measured value as: x = y(Max - Min) / 2047 + Min, where y is the transmitted value.

Select Outputs/TxLimit
When Yes, the Max value will be transmitted whenever the value exceeds Max, and the Min value will be transmitted whenever the value is less than Min. For example, if Min is -10 and Max is 10 and the measured value is 12, then 2047 is transmitted to represent the value 10. If

the measured value is -12, then 0 is transmitted to represent the value -10.

When No, the "roll-over" or "roll-under" value is transmitted. For example, if Min is -10 and Max is 10 and the measured value is 12, then 205 is transmitted to represent the value -8. If the measured value is -12, then 1842 is transmitted to represent the value 8.

Select Outputs/HoldOffSec
Number of seconds to wait after one transmission of this sensor value before allowing another to be sent, unless the transmission was triggered by exceeding Override.

Select Outputs/Tx Now
Pressing SET with Tx Now highlighted will cause the current sensor value to transmit now.

Station Setup/Communications/COMx Iridium

This menu provides access to all Iridium settings needed to configure the IRIDIUM modem for self-timed and/or alarm transmissions, as well as command processing. A typical Iridium Settings menu is shown below followed by a description of all the fields.

```
              Iridium COMx:
Enabled                                  No
TxInterval                         01:00:00
TxTime                             00:00:00
TxRetransmit                            Yes
TxFormat                     Pseudobinary-C
AlarmData                        AllSensors
IncludeHeader                           Yes
IncludeStationName                       No
TxOnGPRSFailOnly                         No
MsgInterval                        00:00:00
MaxDailyBytes                         10000
PwrOnInterval                      00:00:00
PwrOnTime                          00:00:00
PwrOnDuration                      01:00:00
SetupPassword
DataPassword
SyncTime                                Yes
LocalTimeOffset                           0
Select outputs       ►
End Iridium Menu
```

Enabled
This property must be set to YES to enable Iridium processing, including self-timed and alarm transmissions, as well as incoming message processing.

TxInterval
The property, along with the TxTime property, determines when transmissions are made. The units for the rate are HH:MM:SS. Typical rates are 01:00:00 for hourly transmissions and 04:00:00 for transmissions every 4 hours.

TxTime
TxTime is the transmission time assigned to the station. It is used to specify an offset to TxInterval for transmissions. For example, if TxTime is "00:15:00" while TxInterval is "01:00:00", then hourly transmissions will be made at 15 minutes past the hour.

TxRetransmit
When "Yes", data from failed transmissions (due to temporary lack of satellite in view, for example), are retransmitted on the next successful connection. Note that the most recent data is always transmitted first on the first successful reconnect, followed by the oldest to newest data from failed transmissions.

TxFormat
Several formats are supported. Please refer to Appdendix D, Telemetry Formats, for information on specific formats.

AlarmData
This property helps determine how much data is sent in an alarm transmission. When set to "AllSensors", all sensors are included in the transmission. When set to "SensorsInAlarm", the transmission includes only sensor(s) that have triggered an alarm since the last transmission (note: the Pseudobinary B, NIFC, and NFDRS formats transmit all data even when SensorsInAlarm is selected, since decoding those formats depends on the entire content being present).

IncludeHeader and IncludeStationName
These two options determine the content to include in the header of all Iridium transmissions. The header identifies the content of the message (self-timed, alarm, etc.), and provides sizing information that can be used to "stitch" multiple Iridium SBD messages together into a larger data set (as is required when the data to be sent is larger than the maximum size allowed for SBD messages of 340 bytes).

When IncludeHeader is No, no header is included. IncludeStationName is available only when IncludeHeader is Yes. When IncludeStationName is Yes, the station name is included as the last item in the header.

TxOnGPRSFailOnly
When Yes, Iridium will only proceed with a scheduled transmission when the on-board GPRS modem fails to indicate it succeeded in its transmission within 3 minutes. This allows you to use Iridium as a back-up to GPRS transmissions, transmitting only when GPRS has failed to transmit its data to the Primary or Secondary server.

To use Iridium as a back-up to GPRS, set TxOnGPRSFailOnly to "Yes", and configure Iridium's TxInterval and TxTime to be the same as GPRS's TxInterval and TxTime. Also, make sure to configure the GPRS and Iridium settings on each measurement output you wish to include in the transmissions. Since both GPRS and Iridium settings can be defined for each measurement output, you have the option to transmit less data over Iridium if desired to reduce data cost.

NOTE: TxRetransmit must be set to No in order to be able to access this setting.

MaxDailyBytes
When TxOnGPRSFailOnly is "Yes", the system will stop making scheduled Iridium transmissions for the day once the total number of bytes transmitted in the day so far meets or exceeds the value of MaxDailyBytes. This limit only applies when TxOnGPRSFailOnly is Yes, and never applies to alarm transmissions, nor when transmitting responses to commands received via SBD message over Iridium.

The value of MaxDailyBytes can be changed by sending a command to the 8310 via Iridium short burst message:

```
!irsmdb nnn
```

For example, to set MaxDailyBytes to 20000, send "!irsmdb 20000".

MsgInterval

Specifies the interval at which the system will connect to the Iridium satelite to check for incoming messages. Whenever the interval overlaps with a self-timed transmission or PwrOnDuration, the message check is ignored (since message checks are automatic in those instances).

How to Send a Command via Iridium

To send a command to the 8310 via Iridium, simply send an email message to data@sbd.iridium.com, with the modem's IMEI number on the subject line, and a text file attachment with ".sbd" extension containing the command(s) to be processed. The email message body should be left empty. The response to the command, if any, will be sent according to the provisioning of the modem (typically either by email or DirectIP).

Multiple commands may be issued using one text file, by putting a single command on a single line. For example, the following file contents would request the contents of the setup file, followed by the current system time…

Example file "commands.sbd":

```
type 8310.ssf
time
```

When "SetupPassword" and "DataPassword" are defined, each line of commands need to include that code. When including an authentication code, put it before the command. For example, if the authentication code is "mycode", then the file above becomes:

Example file "commands_with_authentication.sbd":

```
mycode type 8310.ssf
mycode time
```

PwrOnInterval + PwrOnTime + PwrOnDuration

Specifies when and for how long the system will power-on the Iridum modem to listen for incoming messages. PwrOnInterval specifies how often to power on, PwrOnTime specifies an offset to the interval, and PwrOnDuration specifies how long to stay powered.

For example, with PwrOnInterval = "01:00:00", PwrOnTime = "00:30:00", and PwrOnDuration = "00:15:00", the modem will be powered on every hour at half-past the hour, and will stay powered for 15 minutes.

SetupPassword and DataPassword

These two properties specify authorization codes used to validate incoming command messages. SetupPassword specifies the authorization code for "setup-level" access, while DataPassword specifies the authorization code for "data-level" access.

Incoming command messages have setup-level access by default. When the SetupPassword property contains an authorization string, any and all incoming messages that normally require setup-level access to be processed must prefix the command with the authorization code. For example, to command the station to reboot with an authorization code of "MyAuthCode", the incoming message content would be "MyAuthCode !reboot".

SyncTime + LocalTimeOffset

When SyncTime is set to "YES", the system synchronizes its system time to Iridium time once daily. Iridium time is GMT (Greenwich Mean Time). To set the time to local time, enter the difference in number of minutes between GMT and local time into LocalTimeOffset. For example, Eastern Standard Time (EST) is 5 hours behind GMT. Hence, to sync the logger to EST

time using the Iridium clock, you would set LocalTimeOffset to 300.

The Iridium system provides GMT time using a counter relative to an "epoch" time defined by the Iridium authority. The epoch time changes roughly every 7 or so years. In order for the logger to compute system time properly through a change to the Iridium epoch, the logger must store both the current epoch time, and the next expected epoch time. As of version 2.7, the 7310/8310 logger is programmed to handle an Iridium epoch change in May, 2014.

Iridium will announce new epoch changes in coming years. When a new epoch date is announced, the logger must be told to store the new date. To change the value of the next epoch date-time stored in the logger, send the following command to the logger via Iridium short burst message:

irsenxt MM/DD/YYYY HH:MM:SS

For example, to set the next epoch date-time to 5PM June 3, 2020, you would send, "irsenxt 06/03/2020 17:00:00".

It's also possible to set the current Iridium epoch date-time in the logger, though this would only be required if the logger failed to set the proper epoch date itself during an epoch transition. To set the current epoch date, you would send the command, "irse MM/DD/YYYY HH:MM:SS". Again, the irsenxt and irse commands must be received via Iridium short burst data (SBD) message to take effect. These commands won't work if issued over the logger command line.

Select Outputs

This menu shows a list of TxContent property values for all the outputs in the system. Pressing SET/ENTER on one of the values will take you to the Iridium COMx menu for that particular output, where you can change the value of TxContent, as well as view/change other properties that affect Iridium transmissions.

Note: this is the same as the Iridium Settings accessed via Measurements/Mx/Ox/ Iridium Settings. Changes can be made from either menu.

Select Outputs/TxContent

This property specifies what data to include in the transmission. See the following table for possible values:

All		All the data logged for the output since the last transmission will be transmitted
Individual		Individual values logged for the output since the last transmission will be transmitted.
	DataInterval	the time interval between readings from the 8310 log
	DataTime	the time at which to begin extracting data from the log in order to build a message
	NumVals	No. of data items for each parameter taken from 8310 log and encoded in each self-timed transmission
Last		Only the last value measured will be transmitted.
Exclude		Do not transmit this output.

Select Outputs/Sequence
Sequence determines the order of this output in the transmission message.

Select Outputs/TxAlarmMode
TxAlarmMode specifies when to trigger an alarm relative to the sensor going into and/or out of alarm.

When TxAlarmMode is "TxIn", an alarm transmission is triggered when the sensor enters an alarm state (e.g., exceeds the hi-limit alarm threshold). When TxAlarmMode is "TxInAndOut", an alarm transmission is triggered when the sensor enters or exits an alarm state (exiting an alarm state occurs when the sensor value is less than the limit by more than the deadband amount).

When TxAlarmMode is "Off", no alarm transmission is ever triggered by the sensor going into or out of an alarm state.

Station Setup/Communications//LAN > details

```
Power                                Scheduled
PwrOnInterval                         01:00:00
PwrOnTime                             00:55:00
PwrOnDuration                         00:10:00
TxEnabled                                  Yes
TxInterval                            01:00:00
TxTime                                00:00:00
TxRetransmit                               Yes
TxFormat                        Pseudobinary-C
AlarmData                           AllSensors
TxServers (2)          ►
SecondaryIP
MessagePort
ServerPassword
Use DHCP                                    No
Ip Address                          IP address
Subnet Mask                         IP address
Default Gateway                     IP address
Primary DNS                         IP address
Secondary DNS                       IP address
Primary WINS                        IP address
Secondary WINS                      IP address
Select outputs         ►
```

Power
OFF – the Ethernet port is powered off.

ON – the Ethernet port is always powered on, regardless of whether it is being used.

AUTO – the Ethernet port is powered only when the 8310 determines it needs the port powered to perform some function. For example, when configuring the 8310 as a MODBUS master, AUTO allows the Ethernet port to be off until it's time to perform MODBUS communications.

Scheduled – the Ethernet port is powered on according to a scheduled specified by PwrOnInterval, PwrOnTime, and PwrOnDuration.

PwrOnInterval + PwrOnTime + PwrOnDuration
PwrOnTime, PwrOnInterval, and PwrOnDuration are used to specify when the modem is powered PwrOnInterval specifies how often to power on, PwrOnTime specifies an offset to the

interval, and PwrOnDuration specifies how long to stay powered.

For example, with PwrOnInterval = "01:00:00", PwrOnTime = "00:30:00", and PwrOnDuration = "00:15:00", the modem will be powered on every hour at half-past the hour, and will stay powered for 15 minutes. With the LAN powered, the station will accept incoming connections (e.g., TELNET, SMS, TCP/IP, etc.).

TxInterval

This property, along with the TxTime property, determines when transmissions are made. The units are HH:MM:SS. Typical rates are 01:00:00 for hourly transmissions and 04:00:00 for transmissions every 4 hours.

TxTime

TxTime is the transmission time assigned to the station. It is used to specify an offset to TxInterval for transmissions. For example, if TxTime is "00:15:00" while TxInterval is "01:00:00", then hourly transmissions will be made at 15 minutes past the hour.

TxRetransmit

When "Yes", data from failed transmissions (due to temporary lack of server access, for example), are retransmitted on the next successful connection. Note that the most recent data is always transmitted first on the first successful reconnect, followed by the oldest to newest data from failed transmissions.

TxFormat

The formats allowed are the same for Iridium (not sure if this part is something that will be universal)

AlarmData

This property helps determine how much data is sent in an alarm transmission. When set to "AllSensors", all sensors are included in the transmission and sent as if a self-timed transmission. When set to "SensorsInAlarm", the transmission includes only the sensor(s) triggering the alarm.

TxServers (n)

This menu is used to configure destination servers for self-timed and alarm transmissions.

```
               TxServers (2)
TX1: HydrometCloud.c ►
TX2: AutopollServer. ►
Add Server
Delete Server
Enabled                                  No
TxMode                          All Servers
End TxServers
```

Each server is defined by an IP Address, IP Port, and Tx Protocol. Some Tx Protocols support an additional setting of Server Password.

A Tx Protocol of "Hydromet Cloud" is used to transmit to Sutron's Hydromet Cloud data service, or to your own server running Sutron's Autopoll. When transmitting to Hydromet Cloud, set IP Address to "HydrometCloud.com" and IP Port to 15001, and be sure to enter your Server Password.

A Tx Protocol setting of "None" simply transmits the data over socket to IP Address and IP Port.

Station Setup/Communications/COMx GPRS

This menu provides access to all GPRS settings needed to configure the GPRS modem for self-timed and/or alarm transmissions via GPRS and/or SMS communication, as well as command processing. A typical GPRS Settings menu is shown below followed by a description of all the fields.

```
                GPRS COMx:
Enabled                                    No
TxInterval                           01:00:00
TxTime                               00:00:00
TxRetransmit                              Yes
TxFormat                          Pseudobinary-C
AlarmData                            AllSensors
TxServers (2)              ►
PwrOnInterval                        00:00:00
PwrOnTime                            00:00:00
PwrOnDuration                        01:00:00
PwrOnAction                            Listen
ConnectPrimaryIP                   IP address
ConnectSecondaryIP                       None
ConnectPort                              3001
ConnectPassword
CSDShoulderTap                             No
SMSTxMode                                None
SMSTxList
SMSAlarmsEnable                            No
SMSNotifyEnable                            No
SMSNotifyList
DataPassword
SetupPassword
DataUserList
SetupUserList
ModemAPN
ModemUserName
ModemPassword
ModemPin
RadioBand                  Quad Mode (default)
Warmup                                      0
UseDigIO                                   No
RelayModule                                 1
RelayChannel                                1
RelayInvertOutput                          No
Select outputs             ►
End GPRS Menu
```

Enabled

Set to "Yes" to enable GPRS processing, including self-timed and alarm transmissions via GPRS and/or SMS communication, and command processing.

TxInterval

This property, along with the TxTime property, determines when transmissions are made. The units for the rate are HH:MM:SS. Typical rates are 01:00:00 for hourly transmissions and 04:00:00 for transmissions every 4 hours.

TxTime

TxTime is the transmission time assigned to the station. It is used to specify an offset to TxInterval for transmissions. For example, if TxTime is "00:15:00" while TxInterval is "01:00:00",

then hourly transmissions will be made at 15 minutes past the hour.

TxRetransmit

When "Yes", data from failed transmissions (due to temporary lack of network access, for example), are retransmitted on the next successful connection. Note that the most recent data is always transmitted first on the first successful reconnect, followed by the oldest to newest data from failed transmissions.

TxFormat

Several formats are supported. Please refer to Appdendix D, Telemetry Formats, for information on specific formats.

AlarmData

This property helps determine how much data is sent in an alarm transmission. When set to "AllSensors", all sensors are included in the transmission and sent as if a self-timed transmission. When set to "SensorsInAlarm", the transmission includes only the sensor(s) triggering the alarm. (note: the Pseudobinary B, NIFC, and NFDRS formats transmit all data even when SensorsInAlarm is selected, since decoding those formats depends on the entire content being present).

TxServers (n)

This menu is used to configure destination servers for self-timed and alarm transmissions.

```
               TxServers (2)
TX1: HydrometCloud.c ►
TX2: AutopollServer. ►
Add Server
Delete Server
Enabled                                  No
TxMode                          All Servers
End TxServers
```

Each server is defined by an IP Address, IP Port, and Tx Protocol. Some Tx Protocols support an additional setting of Server Password.

A Tx Protocol of "Hydromet Cloud" is used to transmit to Sutron's Hydromet Cloud data service, or to your own server running Sutron's Autopoll. When transmitting to Hydromet Cloud, set IP Address to "HydrometCloud.com" and IP Port to 15001, and be sure to enter your Server Password.

A Tx Protocol of "None" simply transmits the data over socket to IP Address and IP Port.

PwrOnInterval + PwrOnTime + PwrOnDuration

PwrOnInterval, PwrOnTime, and PwrOnDuration are used to specify when the modem is powered. PwrOnInterval specifies how often to power on, PwrOnTime specifies an offset to the interval, and PwrOnDuration specifies how long to stay powered.

For example, with PwrOnInterval = 01:00:00, PwrOnTime = 00:30:00, and PwrOnDuration = 00:15:00, the modem will be powered on every hour at half-past the hour, and will stay powered for 15 minutes.

When the modem is powered, the station accepts incoming TCP/IP connections (e.g., telnet, Xterm, etc.), and processes incoming SMS messages. The primary reasons to turn off the modem are to reduce power consumption, and to limit time connected to the Cell network.

Note, if the LAN is powered on at the same time that the GPRS is powered on, the LAN will serve as the preferred TCP/IP transport, and may cause a conflict. This is similar to how enabling Wi-Fi

on a cell phone causes communications to be routed using the Wi-Fi interface and not the 3G.

PwrOnAction, ConnectPrimaryIP, ConnectSecondaryIP, and ConnectPort
When set to "Listen" (the default setting), the modem accepts incoming connections during the powered-on period. When set to "Connect", the station attempts to establish an SSP/CL connection to the Primary IP address and IP port specified in ConnectPrimaryIP and ConnectPort, for the duration of the powered-on period. Note, SSP/CL connections support both Xterm (SSP) and command-line (CL) connections. If the attempt to the primary IP fails, the secondary IP is tried.

An Action type of "Connect" can be useful when the IP address of the GPRS modem is unknown. Enabling "Connect" is a way to have the modem "phone home" periodically.

If a user connects to the unit remotely with one of the ways mentioned above, and the self-timed and /or alarm transmission fails to reach the master station the user will get logged out regardless of what the user timeout value is set to in the user settings.

ConnectPassword
When initiating a connection, the station name and this password are transmitted to the server. The server has the option of then accepting or rejecting the connection, based on these login credentials.

CSDShoulderTap
When this option is enabled, a phone call placed to the phone number associated with the SIM card installed in the modem will trigger the station to "call home," i.e., attempt to connect to ConnectPrimaryIP at ConnectPort, with fallback to ConnectSecondaryIP.

SMSTxmode
Transmit Mode enables the user to receive self-timed transmissions using SMS communication, for example, through your phone.

When Transmit Mode is set to "Scheduled", and Transmit List has at least one phone number defined, the user will receive text messages with self-timed transmissions every time a self-timed transmission is supposed to occur based on the transmit Interval and Time in the GPRS Transmit settings. Note, an SMS self-timed transmission may be delayed due to retries to transmit servers, when problems reaching one or more transmit servers occur.

When Transmit Mode is set to "Fallback" and Transmit List has at least one phone number defined, the user will receive a text message with the self-timed transmission content whenever a self-timed transmission fails to reach the destination server.

The format of the SMS self-timed transmission follows the Transmit Format setting in GPRS Transmit settings, unless the selected format is "SSP". When "SSP" is the selected format for the transmission to server, the data is reformatted to "Text" when sent via SMS.

CAUTION: SMS transmissions are limited to 160 bytes of data, and so won't contain any portion of a transmission beyond that limit. Some transmission formats are more compact than others. You may need to experiment with different formats, and/or different "Num Values", in order to receive all data via SMS.

SMSTxList
Enter into Transmit List the set of phone numbers you'd like to receive self-timed and alarm transmissions. Phone numbers should be separated by a comma ",".

SMSAlarmsEnable
When SMSAlarmsEnable is "Yes" and SMSTxList has at least one phone number defined, the

8310 sends alarm messages via SMS. The SMS message includes the station name and time. The format of the alarm transmission depends on whether Alarm Data is "All Sensors" or "Sensors in Alarm".

An example of the Text format used for SMS alarm messages:

RTU01 12:22<cr><lf>

STAGE 4.55 G H+R+<cr><lf>

RAIN 2.0 G OK<cr><lf>

The message begins with the station's name ("RTU01") and the current time in HH:MM (12:22) format followed by a list of sensor readings containing the name of the sensor ("STAGE"), the value ("4.55"), the quality ("G"), and the alarm status ("H+R+").

In the above example "H+R+" indicates that STAGE is experiencing a high limit and high rate of change alarm, while the "OK" status for RAIN indicates that it is within expected limits.

Quality codes:

G: Good quality

B: Bad quality

U: Undefined quality

Alarm codes:

H: High limit exceeded

L: Low limit exceeded

R: High Rate of change

OK: Normal

A "+" after a code indicates that the sensor has just entered that state, while a "-" after a code indicates that the sensor has just exited that state.

SMSNotifyEnable

When set to "Yes", the station reports the following events via SMS to the list of phone numbers in SMSNotifyList:

- Station Rebooted – Indicates that the 8310 unit has rebooted
- Recording on/off – Indicates that the 8310 unit has turned recording on (Recording on), or recording off(Recording off)
- GPRS connect failure - Indicates that GPRS services may not currently be available (a given cell tower may support GSM/SMS services but not GPRS), or that there's something wrong with the APN settings, the account, the provider, etc.
- Shoulder tap failure - If GPRS is unable to perform a shoulder tap that's been requested by the user using SMS, the command line, or by ringing the cell modem (CSDShoulderTap=Yes), then it should send an "STAP failed (could not connect)" SMS notification message. The shoulder tap requires making a TCP/IP connection to the IP and port specified by the command or the primary IP and command port if other settings were not supplied.

SMSNotifyList

Enter into Notify List the set of phone numbers you'd like to receive notifications. Phone numbers should be separated by a comma ",".

SetupPassword and DataPassword

These two properties specify authorization codes used to validate incoming command messages. Setup Password specifies the authorization code for "setup-level" access, while Data Password specifies the authorization code for "data-level" access.

Incoming command messages have setup-level access by default. When the Setup Password property contains an authorization string, any and all incoming messages that normally require setup-level access to be processed must prefix the command with the authorization code. For example, the "REBOOT" command requires setup-level access to execute. Hence, to command the station to reboot given an authorization code of "MyAuthCode", send the message, "MyAuthCode REBOOT".

SetupUserList and DataUserList

These two properties limit SMS access to the phone numbers defined in the corresponding list. A blank list means any phone number is allowed, although it is still subject to Setup Password or Data Password rules, defined above.

SMS command processing

The following commands are supported via SMS:

- Call home (shoulder tap). Initiate an SSP/CL connection to Primary IP and IP Port defined in Connect Settings, or url and port, if specified:
  STAP [url[:port]]
- To set (or show if a setting isn't provided) the ConnectPrimaryIP, ConnectSecondaryIP, or ConnectPort settings:
  SETPIP [url]
  SETSIP [url]
  SETCP [port]
- Command-line commands

Any responses that are generated as a result of the command are sent via SMS to the original sender. The responses are limited in length by the max SMS message length of 160 characters.

ModemAPN, ModemUserName, ModemPassword

The ModemAPN, ModemUserName, and ModemPassword are used to connect to the GPRS modem to the network. The modem's APN is the gateway address for GPRS traffic, to obtain it please call your GSM provider. The username and password are also created by the GSM provider.

ModemPin

The SIM PIN unlock code. This must be specified if the SIM being used is locked. The Diagnostics screen will warn if a SIM PIN is needed and hasn't been entered. Entering the wrong PIN can cause the modem to become blocked, so be careful especially when swapping SIMs.

RadioBand

The Sutron GPRS modem supports multiple bands. Typically in the US the "Quad Mode" can be used, but internationally you may need to select the specific band to prevent frequency hopping and/or roaming. Normally, when a modem is connected to the Xpert for the first time, it is factory reset and programmed to work with pre-configured settings. The "Use Modem Setting" may be used to bypass this initialization and use the settings that were pre-programmed in to the modem. This allows many of the modem settings to be customized in the modem.

The "Janus T2 Modem" and the "Sutron HSDPA Modem" enables support for those specific 3G capable modems, but the settings are similar to the "Use Modem Setting" in that they use the band(s) which have been pre-configured in to the modem. If the default settings are unable to connect to the Cell provider, custom settings may be needed, and the manual(s) for the modem should be consulted. Typically the AT#BND and AT#AUTOBND need to be issued with the desired settings to configure the appropriate bands, and then the AT&W command must be issued to save the changes. Depending on the provider, some of the other settings such as AT#PLMNMODE, AT#ENS, and AT#SELINT) may need to be checked or changed.

Warmup

Set this to the number of seconds to allow the GPRS modem to warm up after asserting power before trying to establish a connection.

UseDigIO, RelayModule, RelayChannel, and RelayInvertOutput

Power to Sutron's GPRS modem is typically supplied via pin 9 of the station's RS232 port. Set UseDigIO to No, and Warmup to 10 seconds, when this is the case. Note, you may need to configure the RS232 port to provide 12V DC on pin 9 using a hardware selectable jumper.

It's sometimes desirable to control power to the modem via external relay. Set UseDigIO to Yes in order to specify a Digital I/O module and output channel (RelayModule and RelayChannel), used to control the relay. The output will be turned "on" before a GPRS connection is attempted. The output is assumed to be an open-collector, hence "on" means 0V is output. If the output instead uses positive logic, set RelayInvertOutput to Yes.

Select Outputs

This menu shows a list of TxContent property values for all the outputs in the system. Pressing SET/ENTER on one of the values will take you to the GPRS COMx menu for that particular output, where you can change the value of TxContent, as well as view/change other properties that affect GPRS transmissions.

Note: this is the same as the GPRS Settings accessed via Measurements/Mx/Ox/ GPRS Settings. Changes can be made from either menu.

Select Outputs/TxContent

This property specifies what data to include in the transmission. See the following table for possible values:

All		All the data logged for the output since the last transmission will be transmitted
Individual		Individual values logged for the output since the last transmission will be transmitted.
	DataInterval	the time interval between readings from the 8310 log
	DataTime	the time at which to begin extracting data from the log in order to build a message
	NumVals	No. of data items for each parameter taken from 8310 log and encoded in each self-timed transmission
Last		Only the last value measured will be transmitted.

Exclude		Do not transmit this output.

Select Outputs/Sequence
Sequence determines the order of this output in the transmission message.

Select Outputs/TxAlarmMode
TxAlarmMode specifies when to trigger an alarm relative to the sensor going into and/or out of alarm.

When TxAlarmMode is "TxIn", an alarm transmission is triggered when the sensor enters an alarm state (e.g., exceeds the hi-limit alarm threshold). When TxAlarmMode is "TxInAndOut", an alarm transmission is triggered when the sensor enters or exits an alarm state (exiting an alarm state occurs when the sensor value is less than the limit by more than the deadband amount).

When TxAlarmMode is "Off", no alarm transmission is ever triggered by the sensor going into or out of an alarm state.

Station Setup/Communications/COMx SATLINK

This menu provides access to all Satlink settings needed to configure the SATLINK for self-timed and/or random transmissions. The menu has three fields that apply to all transmissions and sub menus for self-timed and random transmissions.

```
Satlink COM2
SatID                  00000000
InitSatlink                 YES
LocalTimeOffset               0
SelfTimedSettings >
RandomSettings    >
End Satlink
```

SatID
This property defines the ID used in the satellite transmissions. The same ID is used for both SelfTimed and Random transmissions. This ID is assigned by NESDIS along with a channel, transmission time and interval. The ID consists of 8 characters 0-9, A-F.

Initialize Satlink
The *Initialize Satlink* property determines whether or not to send transmission settings to Satlink at the start of recording. When this box is checked, the transmission settings (times, rates, channels, etc.) are sent to the Satlink whenever the unit is started, otherwise, settings are not sent to the Satlink, but assume instead that Satlink has been configured by some other program (e.g., *Satlink Communicator*).

Local Time Offset
The *Local Time Offset* property defines the difference between the current local time and UTC (Universal Time Coordinated). This offset is sent to Satlink at recording start. The offset is specified in number of minutes, and may be negative. The 8310 uses the local time offset and the UTC time received from Satlink to set the 8310's clock. In addition, the offset is sent to Satlink (Satlink 2's use this value to determine local time).

SelfTimedSettings/RandomSettings
These settings are discussed in the following sections.

Station Setup/Communications/COMx SATLINK/SelfTimed Settings

A typical SelfTimed Settings menu is shown below followed by a description of all the fields.

```
          SelfTimed Settings
Enabled                 Yes
Time                 00:00:00
Interval             04:00:00
Channel                 151
CenterWindow             No
WindowLength          00:00:10
Type              GOES 300 bps
Format                 SHEF
AppendLatLon             No
AppendQuality            No
Select outputs     >
End SelfTimed Settings
```

Enable

This property must be set to YES for the system to make self-timed transmissions. This property is sent to the Satlink to configure it and uses the field to control its own scheduling.

Time

Time is the transmission time assigned to the station. Each station will have a unique transmission time, rate and channel assigned by NESDIS, EUMETSAT or other authorized agency. The transmission time is entered in UTC.

Interval

The Rate, along with the transmission time determines when transmissions are made. The units for the rate are HH:MM:SS. Typical rates are 01:00:00 for hourly transmissions and 04:00:00 for transmissions every 4 hours.

Channel

This property defines the channel that Satlink will use to make the self-timed transmission.

Center in Window

This box instructs Satlink to center each timed transmission in the transmission window. Normally, a transmitter has a transmission window that is larger than the length of the transmission it must make. When "Center in Window" is selected, Satlink will delay each transmission so it is centered in the window. The Window size is entered in the Window Property on this dialog.

WindowLength

This property defines the size of the window, in HH:MM:SS, that is given for the transmission.

Type

The Type property defines the satellite type and baud rate for the transmission. The following satellite types are supported:

- GOES Domestic 100, 300, 1200 bps, timed and random reporting
- GOES Domestic V2 300 G11/G12, 300 G13+, 1200 G11/G12, 1200 G13+

- GOES International
- Meteosat, MSG (Meteosat Second Generation) 100 bps channels, timed and alert reporting
- Japan MTSAT 100 (GMS) bps domestic and international channels
- Japan MTSAT 300 bps
- INSAT 4800 bps domestic channels
- FY2B 100 bps domestic channels
- ARGOS/SCD

Antenna

When the current satellite Type is set to one of the V2 types (300 G11/G12, 300 G13+, 1200 G11/G12, or 1200 G13+), then the Antenna type selection becomes available for selection. Please see the Satlink user manual for information on choosing the best antenna for your application.

Format

Several formats are available. Please refer to Appdendix D, Telemetry Formats, for information on specific formats.

Append Lat/Lon

Satlink transmitters have a GPS (Global Positioning System) receiver which is capable of determining its latitude and longitude. This check box instructs Satlink to add the Latitude and Longitude to the end of each transmission.

Append Quality

This check box configures Satlink to append quality data to the end of the transmission.

Select Outputs (SelfTimed Settings)

Each of the outputs of the 8310 is displayed in a list along the user setting of All, Individual, Exclude as described below. To change the setting press SET/ENTER and select the desired value.

Note: this is the same as the SelfTimed Settings accessed via Measurements/Mx/Ox/Select Outputs/Satlink Selftimed. Changes can be made from either menu. Note also that the system will default the setting for O1 of a measurement to ALL when the measurement is setup as long as Satlink Selftimed is enabled. All other outputs default to Exclude and must be changed individually as needed.

All		All the data logged for the output since the last transmission will be transmitted
	Sequence	Sequence determines the order of this output in the transmission message.
Individual		Individual values logged for the output since the last transmission will be transmitted.
	DataInterval	the time interval between readings from the 8310 log

	DataTime	the time at which to begin extracting data from the log in order to build a message
	NumVals	No. of data items for each parameter taken from 8310 log and encoded in each self-timed transmission
	Sequence	Sequence determines the order of this output in the transmission message.
Exclude		Do not transmit this output.

Station Setup/Communications/COMx SATLINK/Random Settings

A typical Random Settings menu is shown below followed by a description of all the items.

```
          Random Settings
Enabled                No
NormalRate          12:00:00
AlarmRate           01:00:00
BurstRate           00:01:00
NumAttempts                3
Channel                  151
Type                 100 bps
Format               Bin Int
NumVals                    1
GroupLabel                B2
AppendLatLon              No
Select outputs     >
End Random Settings
```

Enable

This box must be checked for the system to make random transmissions. This field is sent to the Satlink to configure the transmitter and uses the field to control its own scheduling.

NormalRate

The "Normal Rate" property defines how often random transmissions will be made, when the unit is not in alarm. The rate is specified in HH:MM:SS.

AlarmRate

The "Alarm Rate" property defines how often random transmissions will be made when the unit is in alarm, following burst transmission(s). The rate is specified in HH:MM:SS.

BurstRate

The "Burst Rate" property defines how often the "# Burst" random transmissions will be made. These burst transmissions occur when the unit first goes into alarm. The rate is specified in HH:MM:SS.

NumAttempts

The NumAttempts property defines how many transmissions Satlink will make when the unit first goes into alarm. This value is normally set to one. When set to a value other than one, Satlink will make this number of transmissions with each transmission separated by Burst Rate

number of seconds.

Channel
This property defines the channel that Satlink will use to make the random transmission.

Type
This property defines the baud rate for the transmission. The valid selections are 100 and 300.

Format
Several formats are supported for random transmissions:

"Bin Int" is a binary interleaved format, identical to the 8210 binary transmission format. The data are in the 6-bit pseudo binary format required by NESDIS.

"Bin NonInt" is a binary non-interleaved format. This format also uses the 6-bit pseudo binary format but allows different amounts of data to be sent for each sensor. The data is not interleaved, i.e., one sensor's data set appears together in the transmission.

NumVals
This property defines the number of values to include in the random transmission. This value is used for the BIN-INT transmission format to set the number of values to send for each sensor (e.g. If set to 32 and 4 sensors are sending data, then a total of 128 data values are sent).

Group Label
The group label to include at the beginning of the pseudobinary random transmision. This is typically "B2", meaning "pseudo-binary, group 2". Only the first three characters of what is entered in this field is included in the transmission.

Append Lat/Lon
Satlink transmitters have a GPS (Global Positioning System) receiver which is capable of determining its latitude and longitude. This check box instructs Satlink to add the Latitude and Longitude to the end of each transmission.

Select Outputs (Random Settings)
This menu allows you to specify which outputs are included in random transmissions. Any output can be included by setting TxContent to Include. For transmissions to actually occur, one of the included outputs must have TxAlarmMode set to TxIn, meaning that entering an alarm on the output should cause a transmission to occur.

When configuring an output for random messages, the following menu will be displayed.

```
          Satlink COM2
M1.O1: TxContent                    Include
Sequence                                  1
NumVals                                   1
TxAlarmMode                            TxIn
DataInterval            00:15:00
DataTime                00:00:00
End Random Settings
```

To assign an output to a group, change **TxContent** to "Include". **Sequence** determines the order of the value in the random transmission, and **NumVals** sets how many values are included in the transmission for BIN-NONINT format, only. The number of values cannot be set in this dialog if the Random transmission format is set to BIN-INT.

If you want this output to trigger a random transmission, set **TxAlarmMode** to "TxIn" and set **DataInterval** and **DataTime** to match the data to include in the transmission (i.e., set them to match the measurement schedule of the output, or some multiple, thereof).

Station Setup/Communications/COMx Modem

The settings for Modem are the same as for Voice except it does not have the following fields:

AnswerMode – answer mode is always data

Language – language only needed for voice

DialInMsg, DialOutMsg – only needed for voice.

Station Setup/Communications/COMx Voice

Sutron's voice modem is capable of both data and voice communications. The settings for the voice modem are as follows:

```
        Voice COM4:
Enabled                 No
BaudRate                115200
MasterID                BASE
AnswerMode              Data
RingToAnswer            2
Language                English
PhoneNumber1
PhoneNumber2
PhoneNumber3
PhoneNumber4
PhoneNumber5
PhoneNumber6
PhoneNumber7
PhoneNumber8
PhoneNumber9
PhoneNumber10
RedialDelay             00:01:00
NumRedials              3
DialInMsg
DialOutMsg
SSP Settings
End Voice COM4:
```

BaudRate

BaudRate sets the baud rate to use when communicating with the modem. The default value is 115,200. This high baud rate can be used even though the communications rate is much slower because of handshaking between the modem and 8310.

Enabled
Set this value to YES to enable *DialOut* messages. With this value set to NO, no *DialOut* messages will be sent.

The Data Modem connection support two types of alarm messages. If a PC Base station is detected, an SSP alarm is sent, otherwise a simple text message is sent and a prompt is made asking for the alarm to be acknowledged.

MasterID
The *MasterID* is used to name the destination whenever the 8310 makes a transmission on this device.

AnswerMode
The Answer mode can be configured to answer in Voice, Data, or Voice & Data. The Voice & Data mode prompts when it answers the phone to "Please press pound". If the person dialing in presses the "#" key on the telephone a voice message is spoken, otherwise a data carrier is transmitted and a data connection is attempted.

RingToAnswer
Define how many rings to wait for before answering the phone.

Language
Speech phrases are stored in the /Flash Disk/speech/English directory or /Flash Disk/speech/[***language]*** directory depending on which language is selected.

PhoneNumberx
When an alarm occurs each phone number is tried in sequence starting with Phone #1, until an acknowledgement occurs. Or until the # Redials has been attempted on each number.

RedialDelay
Defines the amount of time to wait before redialing number for alarms.

NumRedials
When an alarm occurs each phone number is tried in sequence starting with Phone #1, until an acknowledgement occurs. Or until the # Redials has been attempted on each number.

DialInMsg
The Dial-in and Dial-out buttons allow the Dial-in and Dial-out messages to be configured. Speech phrases are stored in the /Flash Disk/speech/English directory or /Flash Disk/speech/[***language]*** directory depending on which language is selected.

DialOutMsg
By default the voice modem will speak the specified Dial Out message. If the modem is unable to detect "ring-back" it may start speaking a phrase before someone answers the phone. Because of this, the message spoken should either be repeated or wait for a button to be pushed before speaking the alarm data.

If a Dial Out message is not defined, or the letter "D" is placed at the beginning of a phone-number, then a data alarm will be sent. The data message will try to automatically detect a PC Base Station and send an SSP message, otherwise a simple text message is sent and a prompt is made asking for the alarm to be acknowledged.

The dial in and out messages are defined by a sequence (list) of commands set by the user. The commands generally are configured to speak the last measured value for selected outputs. They can also be used to give alarm information, prompt the user to press certain keys etc. The following is a complete list of the available commands. The menus make it easy to add, delete,

or move commands in the list.

Command	Description
AckAlarms	Acknowledge alarms in the system. Further alarm transmissions will cease until a new alarm occurs or it's time for an alarm transmission.
AnswerData	Switches to answering the phone in data mode.
Branch	Branch to another part of the speech command specified by a user Label. Searching for the label begins with the first line in the speech command.
BranchDTMF	Wait for and branches based on a DTMF press. Searching for the label begins at the current line in the speech command. The phone will be hungup after 60 seconds if a button is not pushed.
BranchNoDTMF	Same as Branch, but the Branch is only performed if a DTMF button was not pressed on the phone. This is usefull for repeating a series of phrases over and over until the user pushes a button. If a button is pushed, it will be queued, and should be processed by a BranchDTMF command. Normally there is a 90 second inactivity timeout that is reduced to 60 seconds when this command is used. The phone is hungup if an inactivity timeout occurs.
Call	Calls a subroutine in another part of the speech command specified by a user Label. This works just like the Branch command, except that control may be returned to the command after the Call when a Return is encountered. Subroutines may call other subroutines.
DisableAlarms	Disables further alarm transmissions using the Voice modem and other SSP devices such as LOS Radio. They may be re-enabled using the EnableAlarms command, by Basic program, or by accessing the main menu and pressing SET on the "Sending Alarm Txs: DISABLED" item.
EnableAlarms	Re-enables alarm transmissions that have been disabled with DisableAlarms.
Hangup	Hang up the phone and terminates the speech command
InputManual	Input a number from the user. The number is entered with the DTMF keypad. "*" may be used to specify a decimal point. Press the "#" button is used to indicate the end. Pressing "*" twice will allow the number to be re-entered. See SpeakManual, and StoreManual. Example: 12*345# would enter the number 12.345. Negative numbers are not supported.
Label	Label a section of the speech command, two types of labels exist. User and DTMF. DTMF labels are branched to in response to the BranchDTMF command, and user labels are branched to using the Branch command.

Language	Switches to the specified language. This effects all speech phrases that may be spoken (ex: SpeakPhrase and SpeakData). Please note that any phrases specified in subsequent SpeakPhrase commands which don't exist in the specified language will be updated to phrases that do.
Pause	Delay the speech command for the specified number of seconds (resolution down to milliseconds)
Return	Returns from a subroutine by branching back after the last Call command. If the Call command wasn't used, then control passes to the beginning of the phrase..
SpeakAlarms	Cause all sensors with IsSSPCurData set to "Yes" to have their prefix phrase, value, suffix phrase and alarm status spoken.
SpeakAllTags	Cause all sensors with IsSSPCurData set to "Yes" to have their prefix phrase, value, suffix phrase and alarm status spoken.
SpeakData	Speak just the last measured data value of the specified sensor.
SpeakLiveData	Force measurement and speaks just the live data value of the specified sensor.
SpeakLiveTag	Force measurement and speaks the prefix phrase, live value, suffix phrase and alarm status of the specified sensor.
SpeakManual	Speak the last data entered by the user with the InputManual command (or 0 if no value has been entered).
SpeakNum	Speak the specified number.

Example DialInMsg

```
Label USER-0
SpeakPhrase Hello welcome to the Sutron 8310
Pause 1.0
SpeakPhrase Please press pound
Pause 2.0
BranchNoDTMF USER-0
BranchDTMF
Label DMTF-#
Label USER-1
SpeakPhrase For live data
SpeakPhrase Please press
SpeakPhrase 1
Pause 1.0
SpeakPhrase To acknowledge alarms
SpeakPhrase Please press
SpeakPhrase 2
Pause 1.0
SpeakPhrase To hang up
SpeakPhrase Please press
SpeakPhrase 3
BranchDTMF
Label DTMF-1
```

This introduction is repeated over and over (for up to 60 sec) until the user presses the "#" button on the phone

BRANCH DTMF will go to the DTMF number pressed

DTMF 1 speaks tags and DTMF 2 Acknowledges alarms, speaks alarms and then returns to the top menu (with BRANCH USER-0), DTMF 3 will hang-up the

SpeakAllTags
Pause 1.0
Branch USER-1
Label DTMF-2
AckAlarms
SpeakPhrase Alarm
SpeakPhrase Acknowledge
SpeakPhrase Thank you
Pause 1.0
Branch USER-1
Label DTMF-3
SpeakPhrase Thank you
SpeakPhrase Please call again
Hangup
Label DTMF-ANY
Branch USER-1

Station Setup/Communications/LAN

The LAN menu configures the 8310 to make alarm transmissions using TCP/IP (Ethernet) as shown below.

```
                LAN
Enable                                  Yes
MasterID                               BASE
URL1
Type1                                   Off
UserName1
Password1
Port1                                    23
URL2
Type2                                   Off
UserName2
Password2
Port2                                    23
URL3
Type3                                   Off
UserName3
Password3
Port3                                    23
SendToAll                               Yes
TxNormalRate                       00:00:00
TxAlarmRate                        00:00:00
End LAN
```

The following sections document the fields.

Enabled

Enabled determines whether or not the 8310 will send alarms via the LAN. The default setting is No, meaning that no alarms will be sent. With the setting of Yes, the user can specify up to 3 destinations for an alarm. For each type alarm destination, the user will specify the URL, TYPE,

USERNAME, PASSWORD and PORT.

URLx
This field specifies the destination for the alarm. The URL can be a name such as "alarms.sutron.com" or an IP such as 192.168.20.14.

Typex
The 8310 supports 3 types of alarm transmissions via the LAN device:

DATA -- sends an ASCII format message, alarms are automatically acknowledged.

SSP -- sends an SSP format message.

COMPUTER -- sends an ASCII message and then prompts "Press Enter to acknowledge alarms". Computer acknowledges by sending a CR as prompted.

Keep in mind that type=DATA will behave as if the alarm was acknowledged meaning further URL's will not be attempted unless SendToAll has been set to Yes.

UserNamex
Only used by SSP when the master station requires login

Passwordx
Only used by SSP when the master station requires login.

Portx
TCP/IP port at the master station for the communications.

SendToAll
YES – send to all simultaneously.

NO – send sequentially to URL1, 2, 3. Any acknowledgement of the alarm stops stops the output.

TxNormalRate
This field is in the format HH:MM:SS and defines how often to send selftimed alarms when the system is not in alarm. This could be set to 24:00:00 just to be sure that the system is still operating.

TxAlarmRate
This field is in the format HH:MM:SS and defines how often to send selftimed alarms when the system is in alarm. This may be set to a moderate rate (say 00:05:00) to provide constant updates of the current data while an alarm condition exists.

Station Setup/Communications/COMx MODBUS

This menu is used to configure MODBUS communications over a serial bus (COM port). This menu configures serial settings for both Master and Slave operations. "Master" operations are initiated by MBSensor input types and MBOut measurement types. "Slave" operations means the 8310 listens for commands to read and write local Modbus registers, taking action only when a command is received from a Modbus master. Local registers are defined in measurement output settings menus. See MODBUS for more information on how to define local registers.

```
                    MODBUS COMx
Slave                                   Yes
```

```
DeviceID                                    1
BaudRate                                19200
Parity                                   None
Protocol                                  RTU
RTSPreDataMS                               10
RTSPostDataMS                               0
WaitForDSR                                 No
WaitForCTS                                 No
RS485                                      No
End MODBUS Menu
```

Slave

When Yes, the com port is used for Modbus slave operations. This means the 8310 listens for incoming master communications (register reads, writes, etc.), and processes them when received. When No, the com port is used Modbus master operations, like those initiated by the MBOut measurement type and the MBSensor input type.

DeviceID

This property is visible only when Slave is Yes. The property identifies the slave address of the 8310 on a MODBUS serial bus. The 8310 will process all messages it receives that contain this address in the device id field of the message (as well as "broadcast" messages, i.e., device id 0). This device id applies only to this particular modbus slave, not to the Xpert as a whole, allowing different slaves to have different device ids.

BaudRate

This property identifies the baud rate to use for MODBUS communications over the selected comm port.

Parity

The parity property identifies the parity setting of the comm port. The possible selections are even, odd, and none.

Protocol

This identifies the message format and framing protocol to be used during serial communications. The possible selections are either RTU or ASCII. The default is RTU.

RTSPreDataMS

This property identifies the number of milliseconds to wait after asserting RTS before starting data transmission. The default is 0ms.

RTSPostDataMS

This property identifies the number of milliseconds to wait after data transmission is complete before de-asserting RTS. The default is 0ms.

WaitForDSR

This property specifies whether the DSR (data-set-ready) signal is monitored for output flow control. If this box is checked and the DSR input control line is low, output is suspended until DSR is high again.

WaitForCTS

This property specifies whether the CTS (clear-to-send) signal is monitored for output flow control. If this box is checked and the CTS input control line is low, output is suspended until CTS is high again.

RS485
This property specifies whether the comm port should be configured for RS485. On the 8310, only COM4 has built-in RS485 support.

Station Setup/Communications/ MODBUSTCP

This menu is used to configure MODBUS SLAVE operation over TCP/IP. Note that "slave" operation means the 8310 listens for commands to read and write local Modbus registers, taking action only when a command is received from a Modbus "master". Local registers are defined in measurement output settings menus. See MODBUS for more information on how to define local registers.

```
                MODBUSTCP
Enable                                  Yes
Port                                    502
UseLAN                                  Yes
End MODBUS Menu
```

Enable
This property determines whether MODBUSTCP services are enabled. When set to Yes, the 8310 listens for, and handles, MODBUS requests on the specified IP Port.

Port
This property identifies the IP Port on which the 8310 will listen for and handle MODBUS TCP requests.

EnableLAN
When "Yes", Modbus powers the LAN (if needed) so that TCP/IP traffic will be directed over its interface. When "No", the LAN is not powered, and ModbusTCP will attempt to another TCP/IP interface, if available, e.g., GPRS. NOTE: if the LAN is powered and connected to a valid network, its interface will always be favored and used over any other available TCP/IP interface.

Station Setup/Basic

The Station Setup/Basic menu contains the following items:

Satlink Selftimed
This item defines a Basic subroutine called when it's time to format a Satlink self-timed message. The basic program may alter the contents of the formatted message.

To create a selftimed formatting routine, create a function with a "SELFTIMED_" prefix. The return value of the function becomes the buffer. For example:

```
Public Function SELFTIMED_STFormatter
   Selftimed_STFormatter = "Test Selftimed Message"
End Function
```

It's possible to append to the buffer, as opposed to simply overwriting it, by taking advantage of string concatenation. The following example appends its message to the current buffer:

```
Public Function SELFTIMED_STFormatter
   SELFTIMED_STFormatter = SELFTIMED_STFormatter + "Hello"
End Function
```

Satlink Random

This item defines a Basic subroutine called when its time to format a Satlink random message. The basic program may alter the contents of the formatted message.

To create a random formatting routine, create a function with a "RANDOM_" prefix. The return value of the function becomes the buffer. For example:

```
Public Function RANDOM_RTFormatter
   RANDOM_RTFormatter = "Test Random Message"
End Function
```

GPRS Selftimed

This item defines a Basic subroutine called when it's time to format a GPRS self-timed message. The basic program may alter the contents of the formatted message. See the "Satlink Selftimed" entry for details on how to created a Selftimed formatting function.

GPRS Alarm

This item defines a Basic subroutine called when it's time to format a GPRS alarm message. The basic program may alter the contents of the formatted message.

To create an alarm formatting routine, create a function with an "ALARM_" prefix. The return value of the function becomes the buffer. For example:

```
Public Function ALARM_ALFormatter
   ALARM_ALFormatter = "Test Alarm Message"
End Function
```

Iridium Selftimed

This item defines a Basic subroutine called when it's time to format an Iridium self-timed message. The basic program may alter the contents of the formatted message. See the "Satlink Selftimed" entry for details on how to created a Selftimed formatting function.

Iridium Alarm

This item defines a Basic subroutine called when it's time to format an Iridium alarm message. The basic program may alter the contents of the formatted message. See the "GPRS Alarm" entry for details on how to created an Alarm formatting function.

Station Setup/Logs

The Station Setup/Logs menu shows a list of all the logs that are in the system, as shown below. The menu also allows you to add or delete logs. Pressing RIGHT with a log highlighted will take you to see the details of log.

```
                Logs (2)
system.log          ►
data.log            ►
Add Log
Delete Log
End Logs
```

Add Log

When adding a log, the system prompts for the Location, Name, and Size properties, as well as the "Wrap data when full" and "Ignore bad data" properties. See the following section for descriptions of these properties.

When selecting the **Location** to store a log, you'll normally select \Flash Disk. However, if you have an SD card inserted, the system will allow you to select the location "\SD Card\". When creating a log on an SD card, be sure to leave the card inserted during normal operation.

When entering the **Name** of the log, you don't need to add an extension, as the system will do that for you.

See Station Setup/Logs/Log Details (below) for information on the remaining properties.

Delete Log

When you select Delete Log, the system will prompt to make sure you really want to delete the log. This is because there is no way to retrieve the data stored in a log once it has been deleted. Use with extreme caution.

Station Setup/Logs/Log Details

Selecting a log under the Station Setup/Logs menu and pressing RIGHT brings up a menu showing the properties of the highlighted log, as shown below.

```
                  data.log
Log Size:                    1000064 bytes
Wrap log when full?                   Yes
Ignore bad data?                       No
Header on export?                     Yes
Bad data value?                       Yes
Value for bad data:                -99999
Add note to log
End data.log
```

Log Size
This property shows the size of the log. You can resize a log by changing its Log Size property. If you make the size smaller, you will lose some of the data in the log.

Each logged data point takes 10 to 15 bytes of memory. Hence, a log file 60,000 bytes in size will hold between 4000 and 6000 data points, or between 1.5 and 2 months of a single sensor measurement, made every 15 minutes. Be careful about making logs too large, as this can slow system performance, particularly where searching or exporting the log is involved.

The minimum log size is 2048 bytes. The maximum log size is the lesser of 2 billion bytes, or the free space available on the storage medium minus a small safety buffer (32k for a storage card, 192k for Flash Disk).

Note: on SD cards with Gigabyte capacities, creating larger log files will take much longer. To create a 100 megabyte (104857600 bytes as entered) log file, the unit will take several minutes. Creating a 1 Gigabyte log file will take over an hour.

Wrap Log When Full
Select Yes to cause data to "wrap" when the log has been filled. "Wrap" data means to overwrite the oldest data with the newest data, once filled. Select No if you want to stop logging any data when the log is full. Note: this setting can only be set when creating a log for the first time.

Ignore Bad Data
Select Yes if you don't want the system to log any data that does not have good ("G") quality. Note: this setting can only be set when creating a log for the first time.

Header on Export
Select Yes to include a header when exporting the log. The header contains station name.

Bad Data Value
Select Yes if you want all data with bad quality to be logged with a particular value. When Yes, the property "Value for Bad Data" can be set to the value to log for data having bad quality.

Add Note to Log
Select this item to enter a note (text you enter) into one of the logs.

Station Setup/Log Records

Use a Log Record to customize the format of your logged data, such that it is easier to understand, graph, process, or otherwise use. A Log Record lets you log multiple data entries using a single timestamp. The following example will demonstrate this capability:

If a Log Record is not set up, the default log entries show each measured value, preceded with its own date and time and appended with the quality and units, such as:

3/14/2011	1:25:00	Rain	2.5	in	G
3/14/2011	1:25:00	Solar	530	W/m2	G
3/14/2011	1:25:00	WindSpd	9.2	kts	G
3/14/2011	1:30:00	Rain	2.6	in	G
3/14/2011	1:30:00	Solar	550	W/m2	G

3/14/2011	1:30:00	WindSpd	9.1	kts	G

A Log Record could be set up to express the same data in the following format, which may be easier to use:

3/14/2011	1:25:00	Rain	2.5	in	G,	Solar	530	W/m2	G,	WindSpd	9.2	kts	G
3/14/2011	1:30:00	Rain	2.6	in	G,	Solar	550	W/m2	G,	WindSpd	9.1	kts	G

With a Log Record, you can choose which pieces if information to log (measurement name, units, quality, and value), change the order in which they appear, place a character between measurements (such as the commas, shown above), and even place a character between the name, quality, value, and units. This provides for easy formatting if using a spreadsheet or other application where the separating character is important.

Using a Log Record is a two part process. First, the Log Record must be created- choose Add Record in the Station Setup/Log Records menu, and define the necessary properties as described below. Second, go to the menu of each measurement output (Station Setup/Measurements/Mx/Mx.Ox) you want to include in the record, and update the RecordID property to refer to the Log Record you just created. See the section Station Setup/Mx/Mx.Ox earlier in this chapter for more information.

The Log Records menu appears like this:

```
           Logs Records (1)
Record01              ►
Add record
Delete record
End Log Records
```

Add Record

When adding a log record, the system prompts for RecordID, *Interval*, and Time. See the following section for descriptions of these properties.

Delete Record

This function deletes a log record. The system prompts for the record to delete, and prompts make sure you want to actually delete the record. Once the record has been deleted, no more records of the selected type will be logged.

Station Setup/Log Records/Log Record Details

Selecting a log record under the Station Setup/Log Records menu and pressing RIGHT brings up a menu showing the properties of the highlighted log record, as shown below.

```
                Record01
RecordID                          Record01
LogFile                \Flash Disk\data.log
Interval                          00:15:00
```

```
Time                                00:00:00
Separator                                  ,
HangingSeparator                          No
Fields (5)                ►
End Record01
```

RecordID
The RecordID property defines the name of the record. Records are logged using this name.

LogFile
This property specifies the log file to which to log the record data.

Interval and Time
These two properties define the schedule of the data to log. You will normally set this schedule and the schedule of all measurements logged within the record to be the same. However, if the schedules differ, the data measured closest to the record's schedule will be logged.

Separator
The Separator property defines the string to use in between each field when formatting the record for output to the log. The separator may be multiple characters.

HangingSeparator
The HangingSeparator property determines whether to terminate the formatted output with a separator character. For example, if the property is checked, and the separator character is a comma (','), the logged data will have a comma at the end, as well as between all fields. If the property is not checked, no comma will appear at the end of the logged data. This property is most useful in ensuring the output is compatible with automatic parsing logic used after the log is downloaded.

Fields (n)
Selecting this item will take you to a list of the measurement outputs that have been assigned as fields for this record, i.e., assigned as values to include in the record. You can update each field's sequence and format, as desired from this menu.

Station Setup/SNTP (time-sync)

The SNTP (time-sync) menu is used to configure time synchronization with an NTP network time source. The menu offers the following settings for edit.

```
Enable                                    Yes
TurnLANOn                                 Yes
RefreshIntervalMinut                    20160
Server1                  tock.usno.navy.mil
Server2                    time.windows.com
Server3
End SNTP (time-sync)
```

When **Enable** is Yes, the logger attempts to set system time using the NTP time source defined by **Server1**. If Server1 can't be reached for some reason, **Server2** is tried. Likewise, if Server2 is unavailable, **Server3** is tried. The attempts to set system time occur at the interval specified in **RefreshIntervalMinutes**. The default setting of 20160 minutes equates to once every 14 days. The minimum value for this setting is 5 minutes.

When **TurnOnLAN** is enabled, the logger will turn on the LAN when SNTP is enabled. Note: power to the LAN is continuous, not just when the time synchronizations occur.

Note, when deploying the logger on a network having public access, it's recommended that additional security be utilized such as an external VPN Firewall (virtual private network) that would restrict access, and provide encrypted and secure communications

Station Setup/Users

Adding one or more users can be a useful tool for restricting privileges to different people. A user can have Setup privileges, with full access to see and change measurement setup properties, or they can be a Retrieval user, having only access to view and download log files. If someone logged in as a Retrieval user tries to access something they need to have Setup privileges for, the 8310 will prompt them to log in as a setup user. Logging in to the 8310 also places an entry in the system log, making it possible to see who was logged in at any time.

After selecting Add User, the following settings will appear.

User name
Choose a user name. User names are not case sensitive. Only numbers and letters are acceptable; symbols are not allowed.

Password
Choose a password. Passwords are not case sensitive. Only numbers and letters are acceptable; symbols are not allowed.

User group
Choosing Setup lets a user have full access to see and change measurement properties, view the logs, use the Diagnostics menu, and perform any other setup changes.

Selecting Retrieval will limit the user to only viewing and downloading the logs. A Retrieval user cannot change or even see the measurement setups and cannot enter the Diagnostics menu.

Timeout
If the user interface is inactive for the number of minutes set in Timeout, user will be logged out.

Allow Command Line, SSP, TCP/IP, and UI
Use these properties to further restrict the privileges of a user.

Station Setup/Advanced Settings

The Advanced Settings menu contains settings that aren't typically needed, but are available nevertheless to change the behaviour of the system. A typical Advanced Settings menu is provided below:

```
FixedInternalPorts                    Yes
Display timeout (s)                   300
Flash Duration (s)                    2.0
Terminal Text Color                   White
Terminal Bkgnd Color                  Blue
End Advanced Settings
```

FixedInternalPorts

When *FixedInternalPorts* is set to "Yes", then COM2 and COM3 (the "internal" ports), always have the same type of communications device specified in the Station Setup/Communications menu. This means that clearing the setup keeps the current setting for the port (e.g., IRIDIUM, GPRS, etc.), rather than clearing it (i.e., setting it to NO CONNECT). Note, however, the settings for the device installed on the port do revert to defaults.

The default setting for *FixedInternalPorts* is "Yes". Setting it to "No" can be useful when you typcially use the same 8310 to setup different configurations for other 8310s, yet to be deployed.

Display Timeout (s)

Specifies the number of seconds the display will wait for input, before turning off.

Flash Duration (s)

Specifies the number of seconds flashed messages will display before reverting to the previous text. If you find it difficult to read the occasional flashed message due to it not being displayed long enough, you can increase the time of the flash here.

Terminal Text Color

Select the color of the text displayed in the terminal interface.

Terminal Bkgnd Color

Select the color of the background displayed in the terminal interface.

Terminal Operations

The Terminal Operations menu is only available on a PC/terminal – it is not available from the front panel. A typical Terminal Operations menu is provided below:

```
Download log
Send Basic to 8310
Get Basic from 8310
Send setup to 8310
Get setup from 8310
Get formatted setup
Upgrade Firmware
```

All terminal operations require a Y-MODEM transfer, which is supported by most terminal programs. Consult the guide to your terminal program on how to send and receive files using Y-MODEM. In general terms, you will select the menu item on the 8310 to prepare the logger for the file transfer, and then go to your terminal program to initiate the file transfer. If you haven't initiated the file transfer within a minute, the 8310 will time-out and not accept the transfer.

Download Log	This function gets a portion or all of a log and saves it on the PC.
Send Basic to 8310	This function gets a Basic program from your PC and loads it onto the 8310.
Get Basic from 8310	This function is used to get a Basic program from the 8310 and save it on the PC.
Send Setup to 8310	This function is used to send (upload) a setup to the 8310.
Get Setup from 8310	This function is used to get the current setup from the 8310 and save it on the PC.
Get formatted setup	This function is used to get the current setup and save it on the PC, in an easily readable text file.
Upgrade Firmware	This function starts the process to update the software in the 8310. See Upgrading the Firmware in Chapter 12 for details on how to use this function.

Diagnostics

The diagnostic menu items give quick navigation to look at all the inputs, outputs, communications and status of the system. The Diagnostic menu also includes SDI tools.

The diagnostics menu appears as shown below.

```
          Diagnostics
Communications (3)  >
Inputs (3)          >
Outputs (3)         >
I/O Modules (3)     >
SDI Tools           >
System Status       >
Selftest            >
Basic Status: RUN
Clear Cal Data
Debug to System Log
Select mux channel
Upgrade Firmware
Exit 8310 application
End Diagnostics
```

Communications (n)

The number in parenthesis is the number of communications port that are configured to operate. The /diagnostics/communications menu displays the state of each communications port and provides a way to run tests on each port and display additional status.

See additional information in Diagnostics/Communications.

Inputs (n)

The number in parenthesis is the number of inputs configured in measurements. The diagnostics/inputs menu allows you to view the last measured value for each input along with the input number and I/O connection information. For many inputs, you can force a live

measurement by pressing SET/ENTER and Calibrate and view the Raw value by pressing RIGHT.

See additional information in Diagnostics/Inputs.

Outputs (n)

The number in parenthesis is the number of outputs configured in measurements. The diagnostics/outputs menu allows you to view the last measured value for each output. For some outputs, you can force a live measurement by pressing SET/ENTER and view data in the log by pressing RIGHT.

See additional information in Diagnostics/Outputs.

I/O Modules (3)

The number in parenthesis is the number of I/O modules installed in the 8310. Each 8310 has at least 3 I/O modules: the display, the analog I/O providing the analog inputs and the digital I/O providing the digital inputs. The I/O Modules menu displays the name for each of the I/O modules and provides details when needed.

See additional information in Diagnostics/I/O Modules.

SDI Tools

This menu provides tools useful in operating and maintaining SDI-12 devices. SDI-12 is an industry standard protocol for serial smart sensors. The tools menu provides functions to find devices that have been connected to the SDI-12 bus and communicate with them.

See additional information in Diagnostics/SDI Tools

System Status

System Status provides a way to view the following types of status: Recent Logged Messages, SW version, communications, basic, I2C, serial number, num resets, and CPLD version.

See additional information in Diagnostics/System Status.

Basic Status: RUN

This item gives the status of the BASIC programs in the system. The status can be

STOP – no programs to run

Clear Cal Data

Cal data are slopes and offsets calculated during the calibration process that are applied to inputs. The calibration data is kept with each measurement input. This function clears the cal data by setting all the calslope to 1.0 and all the caloffset to 0.0.

See additional information in CalSlope/CalOffset.

Debug to System Log

This function instructs the software to produce additional debug information and write it to the system log. Debug information is useful to help troubleshoot incorrect setups.

Select mux channel

This function allows you to manually select channels on a mux, typically for the purpose of making manual measurements.

After pressing SET with this item highlighted, the system prompts you for the mux name, and the initial channel to select, and then clocks-in the selected channel. Once the channel is clocked-in, the system displays a message telling you the channel has been selected and its associated measurement. If the channel is used by more than one measurement, the first will be shown. If the channel is not in use, then no additional information will be displayed.

You may press any key to select the next channel, or when finished press Cancel.

NOTE: while a mux is manually selected, the system will not make scheduled measurements that require that mux, so be sure to exit this menu as soon as you are done taking measurements.

Upgrade Firmware

This function initiates the firmware upgrade process. Pressing SET will cause the system to look for upgrade files on the local Flash Disk and SD Card (if one is inserted). If an upgrade is found, the system will prompt whether to proceed with the upgrade. If more than one upgrade is found and you press Cancel to the first prompt, the system will prompt regarding the next upgrade found.

For more information regarding firmware upgrades generally, see Upgrading the Firmware in Chapter 12.

Exit 8310 application

This function exits/stops the 8310 application. This should only be done when directed to do so by Sutron Customer Service, typically as part of troubleshooting an issue. Exiting the application will cause the system to no longer measure, log, and/or transmit data. To restart the application you must access the 8310 command line (a "Flash Disk>" prompt), and type /Windows/8310.exe.

Diagnostics/Communications

The Diagnostics/Communications menu will appear similar to the one below, listing only those communications devices that have been configured as installed into the system.

```
   Communications (3)
COM1: (Standy-On)  >        Direct
COM2: (Standby-On) >        SATLINK
LAN (Standby-On)   >
Reset Com Device
End Communications
```

Each line of the menu up to and include the LAN entry represent sub-menus for each of the installed communications devices. Each menu title shows the current status of the device (Standby-On, Standby-Off, Disabled, Waiting, Starting, Stopping, Rescheduling, etc.). The type of the device installed is shown to the right (or, on line 2 of the front panel display menu).

Press RIGHT to enter the diagnostics menu for a device. The diagnostics menus for each of the possible device types is discussed next.

Direct / Modem / Radio / RS485 / Voice COMx:Test

The Direct diagnostic menu follows:

```
Rx:0/0,0 bad      Tx:0/0,0 bad
Turn On radio
Turn off radio
Read Mail Messages
Send Mail Message
Send test alarm tx
End Direct COM1: Test
```

See the following table for descriptions of each function:

Rx:0/0, 0 bad	Received data statistics (good packets to this unit/total packets seen, bad crc packets)
Tx:0/0, 0 bad	Transmitted data statistics (packets successfully tx /total packets tx, failed tx)
Turn on radio	Assert RTS
Turn off radio	Deassert RTS
Read mail messages	Check for received SSP mail messages
Send mail message	Send an SSP mail message to another unit
Send test alarm tx	Send a test alarm transmission

Satlink COMx: Test

The Satlink diagnostic menu follows:

```
SelfTimed message
                Message
                Num Chars = 0   Num secs = 0.0
Random message
                Message
                Num chars = 0   Num secs = 0.0
Send to Sutron
                Satellite ID
                Channel
                Type
                Send to Sutron
Satlink Status
Clear status
Reset Failsafe
Reset Satlink
Set factory defaults
End Satlink COMx Test
```

See the following table for descriptions of each function:

SelfTimed message	Shows the current self-timed message, its size (number of bytes), and its length in seconds (i.e., the number of seconds the Satlink device will be on "air", occupying the designated channel space).

Random message	Shows the current random message, its size (number of bytes), and its length in seconds (i.e., the number of seconds the Satlink device will be on "air", occupying the designated channel space).
Send to Sutron	This menu gives the ability to send a test message to Sutron using Satlink.Contact Sutron customer service for assistance in using this feature.
Satlink Status	When you press RIGHT or SET on this menu item, the system retrieves the current status message from Satlink, and diplays it one line at a time. This message is usually quite long. Once the message is displayed, press DOWN and/or UP to move through the message for reading. Press CANCEL to stop navigating through the message, and return to the menu.
Clear Status	Use this menu item to command the Satlink device to clear its status data (counts, errors, etc.).
Reset Failsafe	Use to command Satlink to reset its failsafe.
Reset Satlink	Use to reset the Satlink device
Set factory defaults	Use to command Satlink to reset all of its settings to factory defaults.

Iridium COMx: Test

The Iridium diagnostic menu follows:

```
Modem status                    Standby-Off
Next task                           Nothing
Next task time                         None
Last ST tx                             None
Total ST tx                               0
First missed tx                        None
Skipped ST tx                             0
Next ST tx time                        None
Next ST 0 bytes                        None
Next ST tx size                     0 bytes
Est ST bytes/month                  0 bytes
Last AL tx                             None
Total AL tx                               0
Last messages rx      ►
Last message rx time                   None
Total messages rx                         0
Last pwr-on                            None
Next pwr-on                            None
Last pwr-off                           None
Next pwr-off                           None
Total bytes tx                            0
Total bytes rx                            0
Total tx/rx errors                        0
Signal quality (0-5)                      0
Send test tx                    SET to send
Check message now              SET to check
End Iridium COMx:
```

See the following table for descriptions of each function:

Modem Status	The current operation being performed by the modem. For example, "Starting", "Standby-Off", "Standby-On", "Self Timed Tx", "Alarm Tx", etc.
Next task	The next task to be performed. For example, "Nothing" (nothing scheduled), "MsgCheck", "PwrOn", "SelfTimed", etc.
Next task time	Time of the next scheduled task to perform
Last ST tx	Time of the last self-timed transmission
Total ST tx	Total number of self-timed transmissions so far today
First missed tx	Time of the first missed transmission, if the system has experienced a missed transmission. When no transmission has been missed since the last successful transmission, the value displayed is "None".
Skipped ST tx	Total number of self-timed transmissions skipped so far today due to exceeding MaxDailyBytes (applies only when TxOnGPRSFailOnly is set to Yes)
Next ST tx time	Time of the next self-timed transmission
Next ST	The next self-timed message
Nex ST tx size	The number of bytes in the next self-timed transmission
Est ST bytes/month	Estimated number of bytes per month that will go to scheduled transmissions, computed based upon the current message size and transmission schedule
Last AL tx	Time of the last alarm transmission
Total AL tx	The total number of alarm transmissions today
Last messages rx	Menu showing the last 5 messages received
Last message rx time	Time of the last received message
Total messages rx	Total number of messages received today
Last pwr-on	Time of the last power on
Next pwr-on	Time of the next power on
Last pwr-off	Time of the last power off
Next pwr-off	Time of the next power off
Total bytes tx	Total number of bytes transmitted so far
Total bytes rx	Total number of bytes received so far
Total tx/rx errors	Total number of errors that have occurred while transmitting or receiving. These are the kinds of errors that would occur due to having poor view of the sky for the antenna

Signal quality (0-5)	A number ranging from 0 to 5 to indicate signal quality, with 5 being the best. Press SET/ENTER to update instantaneously
Send test tx	Press SET/ENTER to send a test transmission
Check message now	Press SET/ENTER to check for incoming messages now

GPRS COMx: Test

The GPRS diagnostic menu follows:

```
Modem status                    Disabled-Off
Next task                            Nothing
Next task time                          None
SelfTimed status      ►
Alarm status          ►
Power status          ►
GPRS status           ►
SMS status            ►
Signal Display                         Bars
Signal Strength                         N/A
Send test tx                    SET to send
Send SMS message                SET to send
Last SMS message rx   ►
Send SSP mail                   SET to send
Last SSP mail rx      ►
Turn power on                   Standby-Off
End Menu
```

See the following table for descriptions of each function:

Modem Status	The current operation being performed by the modem. For example, "Starting", "Standby-Off", "Standby-On", "Self Timed Tx", "Alarm Tx", etc.
Next task	The next task to be performed. For example, "Nothing" (nothing scheduled), "SelfTimed", "PwrOn", "PwrOff", etc.
Next task time	Time of the next scheduled task to perform
SelfTimed status menu:	
Last tx	Time of the last self-timed transmission
#Tx today	Number of self-timed transmissions today
First missed tx	Time of the first missed transmission, if the system has experienced a missed transmission. When no transmission has been missed since the last successful transmission, the value displayed is "None".
Next tx time	Time of the next self-timed transmission
Next Tx msg	The next self-timed message
Nex Tx size	The number of bytes in the next self-timed transmission

Est #Tx bytes/day	Estimated number of bytes per day that will go to scheduled transmissions, computed based upon the current message size and transmission schedule
#Tx bytes today	The total number of bytes transmitted today
Alarm status menu:	
Last Tx	Time of the last alarm transmission
#Tx today	The total number of alarm transmissions today
#Tx bytes today	The total number of alarm bytes transmitted today
Power status menu:	
Status	The current status of the modem (On, Off…)
Last pwr-on	Time of the last power on
Next pwr-on	Time of the next power on
Last pwr-off	Time of the last power off
Next pwr-off	Time of the next power off
GPRS status menu:	
#Tx bytes today	Total number of bytes transmitted today
#Rx bytes today	Total number of bytes received today
#Tx/Rx errors	Total number of errors that have occurred while transmitting or receiving. These are the kinds of errors that would occur due to having poor view of the sky for the antenna
Total connect time	The total number of days, hours, minutes, and seconds connected
SMS status menu:	
Last Rx	Time of the last message recieved
#Rx today	Number of message received today
#Tx bytes today	Total number of bytes transmitted today over SMS
#Rx bytes today	Total number of bytes received today over SMS
#Tx/Rx errors	Total number of transmit and receive errors
Signal display	The units to display for signal strength: "Bars" or "dBm"
Signal Strength	Either number of Bars or dBm signal strength
Send test tx	Press SET/ENTER to send a test transmission. The message will be sent in the background, allowing you to navigate to other menus. Return to this menu when you wish to check for the result.

Send SMS message	Press SET/ENTER to send an SMS message. The message will be sent in the background, allowing you to navigate to other menus. Return to this menu when you wish to check for the result.
Last SMS message rx	A menu showing the last 5 SMS messages received
Send SSP mail	Press SET/ENTER to send SSP mail. The message will be sent in the background, allowing you to navigate to other menus. Return to this menu when you wish to check for the result.
Last SSP mail rx	A menu showing the last 5 SSP mail messages received
Turn power on Turn power off	Press SET/ENTER to turn power to the GPRS modem on (or off) until the next scheduled power interval. The command will not take effect until after any in process power operations have completed. The current state of the modem is displayed.

LAN Diagnostics Menu

The LAN diagnostic menu follows:

```
Users                                   User
Next task                             Nothing
Next task time                           None
SelfTimed status      ►
Alarm status          ►
Power status          ►
LAN status            ►
Send test tx                      SET to send
Send SSP mail                     SET to send
Last SSP mail rx      ►
End LAN
```

See the following table for descriptions of each function:

Users	Shows a list of the objects in the system that are using the LAN, and therefore may have requested it to be On. "User" in this field means the user has configured the LAN to be on by way of the Setup\Communications\LAN menu. Other values may be shown when the LAN is on for other reasons
Next task	The next task to be performed. For example, "Nothing" (nothing scheduled), "SelfTimed", "PwrOn", "PwrOff", etc.
Next task time	Time of the next scheduled task to perform
SelfTimed status menu:	
Last tx	Time of the last self-timed transmission
#Tx today	Number of self-timed transmissions today

First missed tx	Time of the first missed transmission, if the system has experienced a missed transmission. When no transmission has been missed since the last successful transmission, the value displayed is "None".
Next tx time	Time of the next self-timed transmission
Next Tx msg	The next self-timed message
Nex Tx size	The number of bytes in the next self-timed transmission
Est #Tx bytes/day	Estimated number of bytes per day that will go to scheduled transmissions, computed based upon the current message size and transmission schedule
#Tx bytes today	The total number of bytes transmitted today
Alarm status menu:	
Last Tx	Time of the last alarm transmission
#Tx today	The total number of alarm transmissions today
#Tx bytes today	The total number of alarm bytes transmitted today
Power status menu:	
Status	The current status of the modem (On, Off…)
Last pwr-on	Time of the last power on
Next pwr-on	Time of the next power on
Last pwr-off	Time of the last power off
Next pwr-off	Time of the next power off
LAN status menu:	
#Tx bytes today	Total number of bytes transmitted today
#Rx bytes today	Total number of bytes received today
#Tx/Rx errors	Total number of errors that have occurred while transmitting or receiving.
Total connect time	The total number of days, hours, minutes, and seconds connected
Send test tx	Press SET/ENTER to send a test transmission
Send SSP mail	Press SET/ENTER to send SSP mail
Last SSP mail rx	A menu showing the last 5 SSP mail messages received

Reset Com Device

Pressing SET will restart communications on the selected device. If the device is a Satlink, it will also be rebooted. This may be useful if the device was power cycled, temporarily disconnected, or just appears to have gotten stuck.

Diagnostics/Inputs (n)

```
          Inputs (7)
M1.I1*: AIO1:1      2.49992 V G
M2.I1: AIO1:1       3.8308 V G
M3.I1: AIO1:1       0 mA B
M4.I1:              1 G
M5.I1: SDI: 0M (para -999.9 G
M6.I1:              0 G
M6.I2: AIO1:1       3.85139 V G
End Inputs

                    RIGHT more, ENTER measure
```

The number in parenthesis is the number of inputs configured in measurements. The diagnostics/inputs menu allows you to view the last measured value for each input along with the input number and I/O connection information. For many inputs, you can force a live measurement by pressing SET/ENTER and Calibrate and view the Raw value by pressing RIGHT.

Mx.Ix: I/O Config curvalue > more SET/ENT measure

MxIx: Calibrate

MxIx: I/O Config

MxIx: Raw Val

Calibrate

The 8310 calibrate function built into the 8310 can compute the slope and offset for you if you are able to place the sensor in known environments. The calibrate function is available from any menu displaying an input such as in Station Setup/Measurements or Diagnostic/Inputs. The calibration process is as follows:

1. User selects Calibrate on an input. The system prompts "Enter current value." The user enters the current value for the input as determined by some other sensor or procedure.
2. System measures the input for the first cal point, then prompts, "Two point cal?"
3. If the user selects NO, the system is done with the calibration procedure, computing only a calibration offset for the sensor.
4. If the user selects YES, the system prompts "Enter second value." The user will normally cause some change for the input sensor and then enter the new current value for the input as determined by another sensor or procedure. The greater the difference between the two calibration values, the better.
5. System measures the input for the second cal point and then computes both a calibration slope and offset for the input.

If at any time, a measurement fails, user is told "Cal failed due to measurement failure."

Note: A single point calibration modifies only CalOffset while a two point calibration modifies

both CalSlope and CalOffset. The calibration slope and offset are kept separate from the Processing Slope and Offset and applied in order to clearly differentiate between calibration values and normal operating values.

Diagnostics/Outputs (n)

```
          Outputs (27)
M1.O1*: RelHumid     1.00 G
M1.O2*: RelHumidMin  2.50 G
M1.O3*: RelHumidMax  2.50 G
M1.O4*: RelHumidCnt  60.00 G
M1.O5*: RelHumidSTD  0.00 G
M2.O1: AirTemp       0.00 G
M3.O1: WaterLevel    0.00 B
M4.O1: Stage         1.00 G
M4.O2: StageMin      1.00 G
M4.O3: StageMax      1.00 G
M4.O4: StageCnt      900.00 G
M4.O5: StageSTD      0.00 G
M5.O1*: TipBkt       -999.90 G
M6.O1: WindMnSpdSclr 0.00 G
M6.O2: WindMnMagUnit 1.00 G
M6.O3: WindMnMagWind 0.00 G
M6.O4: WindMnDirUnit 3.24 G
M6.O5: WindMnDirWind 270.00 G
M6.O6: WindSTDSpdScl 0.00 G
M6.O7: WindSTDDirUni 0.85 G
M6.O8: WindSTDDirWin 2.52 G
          RIGHT to edit SETUP
```

The number in parenthesis is the number of outputs configured in measurements. The diagnostics/outputs menu allows you to view the last measured value for each output. For some outputs, you can force a live measurement by pressing SET/ENTER and view data in the log by pressing RIGHT.

```
          Mx.Ox name curval > viewlog     SET/ENT measure (if supported)
```

Diagnostics/I/O Modules (n)

```
          I/O Modules (3)
DSP1
DIO1
AIO1
Reset module bus
End I/O Modules

                RIGHT shows details
```

The number in parenthesis is the number of I/O modules installed in the 8310. Each 8310 has at least 3 I/O modules: the display, the analog I/O providing the analog inputs and the digital I/O providing the digital inputs. The I/O Modules menu displays the name for each of the I/O modules and provides details when needed.

The following is a typical display of the I/O module information. Note that you don't see the "details" of serial number, address, etc, unless RIGHT arrow is pressed.

```
I/O Modules (3)
DSP1
Serial Number              L00000
Address                    4
Module Number                   1
Type String        LDSPLAY IO 1287 00V2
DIO1
        Same as DSP1
AIO1
        Same as DSP1
Reset module bus
End I/O Modules
```

The function "Reset Module bus" causes the system to issue a reset command to all I/O modules on the bus. This will cause the system to detect any new module on the bus that wasn't automatically detected when it was attached. It should only be used when you suspect the system has not detected all the I/O modules it should, and should only be used when recording is off, as it will cause any I/O measurements scheduled or in progress during the reset, to fail. If you have questions about whether you should invoke this function, please contact Sutron Customer Service.

Diagnostics/SDI Tools

This menu provides tools useful in operating and maintaining SDI-12 devices. SDI-12 is an industry standard protocol for serial smart sensors. The tools menu provides functions to find devices that have been connected to the SDI-12 bus and communicate with them.

The SDI tools menu appears as follows:

```
SDI Tools
Find SDI devices
Show found (0) SDI
Send SDI-12 command
End SDI Tools
```

Each function is discussed below:

Find SDI devices

This function causes the 8310 to issue the SDI-12 identify (I) command to all valid SDI-12 addresses. The search proceeds in the following order: 0…9, A…Z, a…z, /"#$%&'()+,-./{|}~. The

display shows each address being tested.

The search can be interrupted by pressing CANCEL.

The number of devices found is displayed during the search.

Show found (n) SDI

This function lists the identification string for any SDI-12 device found. The identification string usually contains information about the manufacturer, model and version of the product.

Send SDI-12 Command

This function allows you to send a command to an SDI-12 device. Use the UP/DOWN arrows to select a command from the pre-defined list (SDICmds.txt). Use RIGHT to edit the command. Remember that many commands require you to issue the D0 command to view the data. (See *Diagnostics/SDI Tools* for additional information)

Diagnostics/System Status

The Diagnostics/System Status menu provides a way to view the following types of status: Recent Logged Messages, SW version, communications, basic, I2C, serial number, num resets, and CPLD version.

The following is a typical display of the System Status menu information. Note that the intended items are details that you don't see unless you press the RIGHT arrow.

```
System Status
Recent Messages  >
8310 V1.0.0      >
Communications   >
Basic Status     >
I2c Statistics   >
Serial Number            prt004
Num Resets               10
CPLD Version             8320, ver A
End System Status
```

Recent Messages

This menu item shows recent messages from system.log

8310 Vx.x.x

Vx.x.x is the overall version of the 8310 application. The sub menu item lists all the software modules and their versions. All modules except kernel, monitor and loader should have the same version.

Communications

This sub-menu gives status for some of the communications devices:

```
Communications
LAN: NextSt:11:00:00 LastAlarm:10:33:05 LastST:10:00:00
COM1: NextST:--:--:-- LastAlarm:--:--:-- LastST:--:--:--
RADIO2: NextST:12:10:00 LastAlarm:12:05:40 LastST:12:00:00
```

SL3: Started
End Communications

The Communications status menu provides information about the various communications ports in the system.

Com Status: Waiting.
This is the status of the SSP alert manager that manages selftimed and alarm transmissions to data modems, speech modems, and radios, direct connects, RS-485 connections. These are devices which either communicate via SSP or allow access to a command prompt. Possible values include Disabled, Waiting, Starting, Started, Stopping, Stopped, Rescheduling, Sending LAN Alarm, and Dialing Alarm.

COM1: NextST:--:--:-- Last Alarm:--:--:-- LastST:--:--:--
This is an example line for COM1: Since it's not normally configured to send alarms, or periodic transmissions, it typically displays blank time values.

RADIO2: NextST:12:10:00 Last Alarm:12:05:40 LastST:12:00:00
This is an example line for a LOS Radio configured on COM2:. It shows the time the next selftimed transmission is scheduled for as well as the last alarm, and last selftimed transmission. An alarm transmission is transmission sent when a sensor in the system exceeds an alarm threshold.

SL3: Started
This is the status of the Satlink manager that is monitoring the Satlink communicator on COM3:. Possible values include Stopped, Starting, Started, and Stopping.

Basic Status
Basic Status: running]
Scheduled tasks

I2c statistics
This sub-menu lists statistics on the communications with the I/O modules. The statistics are cleared out on startup. Normally the "#Rx Count" and "#Tx Count" will increment as measurements are taken (or other communications takes place) that require I2C modules. Other counts may also increment at times when an error or a collision on the BUS occurs, but typically these are recoverable. A non-recoverable error is indicated by the "#Rx Fail" or the "#Tx Fail" statistics incrementing and will typically result in an error message in the System log. If you experience a high number of failures, the other statistics may help Sutron technicians and engineers determine why.

Serial Number
Serial number assigned at the factory to the main board of the 8310.

Num Resets
Number of resets seen by the 8310.

CPLD version
Version of the CPLD on the main board of the 8310. The CPLD is a custom programmable integrated circuit that controls much of the logic inside of the 8310. The initial version of the CPLD is "8310, ver A". If it is updated the version will become "8310, ver B", "8310, ver C", etc. If

the unit reports that the CPLD is not for the 8310, then it has been incorrectly programmed.

Chapter 5: Quick Setup

This chapter focuses on the 8310 setup and suggests steps to follow to create the setup of the 8310.

Review

In the first three chapters of this manual, you learned how to power up an 8310 and use the front panel and PC menus. You were also introduced to the reference chapter of all the 8310 menu items. In the remaining chapters of this manual, you will learn more about its many applications in actual field operations. Covered in these chapters will be topics such as connecting sensors; the different field setups you may need to configure the 8310 for; using the Basic programming language to maximize your control over the 8310 operation: and other relevant information.

If you are a new user, please work through Chapter 3 before continuing through the rest of this manual. Once you have mastered the concepts in Chapter 3, you will be prepared for the information that follows.

Creating the Setup

We will now take you through the steps to create the setup of the 8310.

If desired, make sure you have a blank setup by issuing the Station Setup/Clear Setup function. This will set the setup to a default state. The default state specifies no measurements, with communications on the internal ports COM2 and COM3 set in their factory condition.

1. Station ID – Enter a name or number for the Station ID. If you are using a telephone speech unit, make it a number so that the ID will be recognizable when it is spoken. The 8310 will also use the ID when communicating using Sutron Standard Protocol.

2. Setup communications devices. Doing this first allows the system to automatically configure measurement outputs to use the devices.

    a. Use the Station Setup/Communications menu to verify your communications devices are setup and configured properly. If not, use the menus to add or change them.

3. Setup measurements. Normally, you'll setup a measurement for each sensor or instrument you want to use. For example, you'll use one measurement for an air temperature sensor and one measurement for a water level sensor.

    a. Use "Station Setup/Measurements/Add Measurement" to add a new measurement to the station.

    b. As you proceed through the process to setup the measurement, you'll have a chance to select the measurement type, name, *Interval*, time, input type(s).

    c. The system gives default values and allows you to accept or change them.

    d. Note that there's an "enable" setting for each measurement. You can use this to turn on and off measurements that may be a part of a general configuration but not part of this particular station.

    e. The measurement setup menu displays a current value for each input (e.g. M1I1 Cur

Val). This gives you a chance to test the measurement of each input to make sure it is connected and configured properly. You can press SET to make a measurement of the input or RIGHT to start a calibration if the sensor is already wired. If the value displayed is not correct, review your setup and correct as needed before going on.

f. When you get to the outputs section of the menu (e.g. M1O1), you'll want to examine each output to make sure the data is displayed, logged and communicated as desired. Not all outputs need to be displayed, logged, or communicated.

g. Repeat to set up all the measurements in the system.

4. Return to the communications menu and make sure that your Satlink (or other communications device) has the proper settings and outputs assigned. In the case of Satlink, check the "SelfTimed Settings" and make sure to "Select Outputs" to view all outputs assigned.

5. Turn Recording ON and use the menus discussed earlier in the Operations section to view inputs, outputs, communications formats etc.

More Complex Measurement Setups

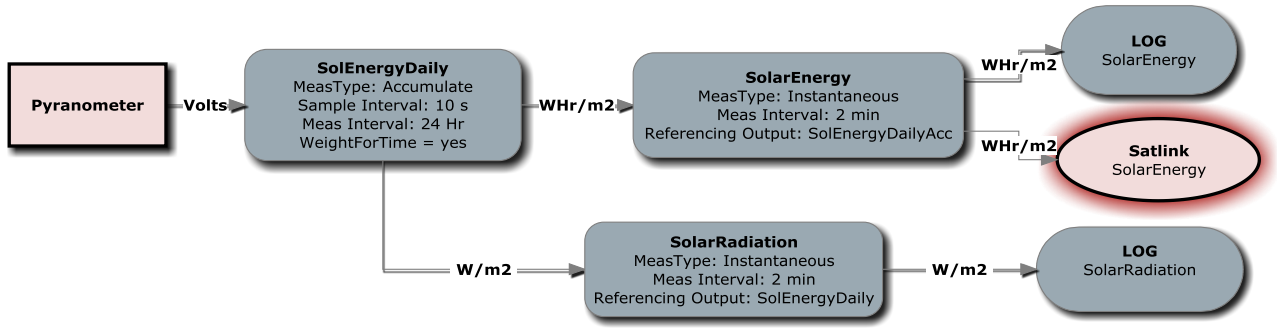
For some applications, a single measurement cannot be configured to record the data you want, such as the current accumulation of solar radiation throughout the day or the intermediate value of an average. In these cases, you can use one measurement to reference another measurement's data to achieve the averaging, accumulating, and logging intervals you want.

The Accumulate measurement type has outputs of a) the accumulation at the end of a measurement interval and b) the accumulation samples (values before the accumulation calculation is performed), output after every sample. What this does *not* achieve is the current value of the accumulation at any time within the measurement interval. To get this current accumulation, you must set up two measurements- the first is the accumulation itself, and the second is an instantaneous measurement whose sole purpose is to get data from the accumulation and log it more frequently. This is done by using Reference as the input type of the second measurement, and choosing the accumulation when prompted for which output to reference.

Understanding this concept of referenced measurements is key to building more complex measurement setups- it lets you access "intermediate" data (data before the measurement interval is complete) for Averages, Vector Averages, and Accumulations. You can use the same referencing concept to take an Average of an Average, take an Average of several Accumulations, or many other combinations. While it may seem difficult at first, this is a very powerful tool once it is understood.

Below is a visual example of a setup used to record the solar radiant energy accumulated throughout the day ($WHrs/m^2$) and instantaneous radiation (W/m^2). The Accumulation, SolEnergyDaily, takes a radiation sample every 10 seconds, and uses these to compute the accumulation of solar energy over 24 hours (with WeightForTime = Yes to convert units to $WHrs/m^2$). SolarEnergy references or "asks" SolEnergyDaily for the current accumulation every 2 minutes, and it performs the output operations configured- logging and transmitting via Satlink

in this case. Remember that an Accumulation also outputs sample data (values prior to accumulation calculation, W/m^2 in this case), which are output every 10 seconds. Logging all the 10 second samples may be more data than you want, so the instantaneous measurement SolarRadiation logs a single radiation sample from SolEnergyDaily every 2 minutes.



Telephone with Speech/Modem

Sutron's voice modem works both as a data modem and as a voice modem. It is commonly connected to COM3. Set the device type to VOICE.

- As you setup each measurement output, make sure you set SSP Settings/SSPEnabled=YES and AlarmsEnabled=YES. This makes the output available for voice and data communications. In addition, if you are going to use voice communications, configure the prefix and suffix phrases with the appropriate phrase. When the 8310 speaks information about an output it first says the prefix (such as temperature), then the value (twenty five point 7), then the suffix (such as degrees). Refer to the table of Speech Phrases in Appendix C.
- If you intend to use "alarms" configure the alarms for the output in the SSP Settings menu.
- Configure the other settings for the VOICE device. The most common setting for Answer Mode is "Voice and Data". In this mode, the 8310 will answer "Please press pound" and pause for a few seconds. If "#" is not pressed, the 8310 will turn on its modem signal and try to establish a data link. The other Answer Modes are available if you need them.
- With The Answer Mode in one of the voice modes, you will want to create a DialIn message. A common dialin message causes the 8310 to speak the ID, speak live (current) data and then give you a menu.
- If you want to dialout on alarms, set Enabled=YES and specify the phone numbers as needed.
- Pick a password for the station to protect your unit from unauthorized users. You can probably use the same password for all your sites.

LOS Radio

The system is ready to operate with LOS Radios with some simple changes to the configuration.

Set one of the communication ports to type=RADIO. With this type, the system will function properly with a radio that requires the radio to be keyed prior to transmission. Radios that do

not require keying can be connected as type SSP or DIRECT.

If you want the 8310 to send alarms, set AlarmEnable=YES.

Set the TxNormalRate and TxAlarmRate if you want the 8310 to make selftimed transmissions of data. Make sure you set the MASTERID to match the name of the master station.

As you setup each measurement output, make sure you set SSP Settings/SSPEnabled=YES and AlarmsEnabled=YES. This makes the output available for data communications. If you intend to use "alarms" configure the alarms for the output in the SSP Settings menu.

Satellite Units -- Self Timed Reporting

Make sure that one of the COM ports is configured for SATLINK

Satlink Setup – use the Station Setup/Communications/COMx SATLINK menu to configure the SatID and the *SelfTimedSettings*. The SatID is assigned by NESDIS in the US (and by other satellite agencies internationally) along with a transmission time, *Interval*, baud rate channel and window. The SatID and transmission time and *Interval* are unique for each station. The transmission time assigned by NESDIS (and entered into the 8310) is a GMT time.

Use the *Select Outputs* sub menu to specify which outputs are included in the self-timed message. Note: you may also use the menu accessed from each output in the station Setup/Measurements/Mx/Mx.Ox menu.

Use the Diagnostics/COMx/Satlink Test menu to display the planned message that will be transmitted. Note that the message may indicate missing data by a M, ???, 9999 or some other means depending on the format.

Satellite Units -- Random Reporting

Make sure that one of the COM ports is configured for SATLINK

Satlink Setup – use the Station Setup/Communications/COMx SATLINK menu to configure the SatID and the *RandomSettings*. The SatID is assigned by NESDIS in the US (and by other satellite agencies internationally) along with a transmission time, *Interval*, baudrate channel and window. The SatID and transmission time and interval are unique for each station. The transmission time assigned by NESDIS (and entered into the 8310) is a GMT time.

Use the *Select Outputs* sub menu to specify which outputs are included in the Random transmission. Note: you may also use the menu accessed from each output in the station Setup/Measurements/Mx/Mx.Ox menu.

To include an output in a random transmission, set its TxContent property to "Include". To use

an output's alarm settings to determine when to make a random transmission, set its TxAlarmMode property to TxIn.

Use the Diagnostics/COMx/Satlink Test menu to display the planned message that will be transmitted.

Recording: OFF/ON

When you are entering the setup, the 8310 keeps Recording OFF. This keeps the 8310 from being confused as you are configuring measurements and communications. With recording OFF, the 8310 will still answer the phone as setup in the Modem setup and will also communicate over a radio. You can also view live data for some sensors while recording is OFF.

When you set Recording ON the 8310 gets to work. It will begin to use the information you entered to measure, sample and log data. The 8310 will check for alarms if enabled and perform alarm actions that have been programmed. If the unit has a GOES radio it will use the setup information to make any scheduled and random transmissions specified.

See the Recording section in Chapter 4 for a complete description of Recording ON.

Chapter 6: Connecting Sensors

This chapter describes how to connect sensors to the 8310. It discusses the different kind of sensors that the 8310 can measure (analog, frequency, counter, quadrature, SDI-12 and RS232) and provides details needed to connect and operate them with the 8310.

Concepts

Connecting sensors is as simple as connecting the wires from the sensor to the terminal strip. As a standard practice you should test each new application (sensor connections and setup) on the bench prior to installing it in the field. Then create a complete setup sheet and wiring diagram that shows where each sensor wires is attached to the 8310. This will take the guesswork out of connecting the sensors in the field.

Analog Inputs

Number Available	8
Input Range	-0.1 to 5V with respect to ground, single ended or differential
Single Ended Range	0-5 V, ± 78 mV (with respect to ground)
Differential Range	±2.5V, ± 78 mV (+ input with respect to – input)
CMRR	120 dB typ
Input Impedance	> 10 Gohm typ
Accuracy:	0.002% of 5V typ 0.003% of 78mV typ HiGain 0.03% of 19.5mV typ x128Gain
Temp Coefficient	5 ppm/C typ
Ratio Accuracy	Limited by A/D resolution
Noise floor	RMS noise typically < 1bit on 78mV scale and above
Excitation	2.5V (up to 50 mA)
Protection	Multistage input protection including spark gaps.
4-20 mA	Precision load available for 2 analog channels. Loop source voltage provided by switched battery voltage

Digital Inputs

Number Available	4 Intended for tipping bucket, frequency or discrete inputs (quadrature takes 2 inputs)
Maximum frequency	8kHz, minimum pulse width 100 microseconds
Input range	0-5V (100KOhm pull-up to +5V provided)
Accuracy	±0.07% @200 ms sample interval ±0.03% @500 ms sample interval ±0.01% @1000 ms sample interval
Max Quadrature Frequency	4kHz

Digital Outputs

Number Available	2
Output type	Open collector with 100 ohm current limiting resistor, 100 mA, 15V max

Switched Voltages

Number Available	2
Types	Switched battery, Switched +5

Input/Output Expansion	Additional analog and digital inputs and outputs can be added via external I/O expansion modules.
Module Types	Analog, 10 channels, 16 bit Digital, 8 channels, input or output

In addition to the external input capability, the 8310 can monitor and log several of its own internal functions including:

- excitation voltage
- Analog Ground voltage
- +5v A/D reference voltage
- Main Battery Voltage

Analog Sensors

Analog sensors are sensors with a voltage output. This voltage can be the result from:

- a reference voltage passing through a resistive device
- a powered sensor that has a voltage or current output
- a self-powered sensor a voltage or current output

Sutron provides 4 different input types for making measurement of analog sensors: voltage, bridge, resistance and 4-20ma. The following table shows the input type best suited for common analog sensors

Sensor	Voltage	Bridge	Resistance	4-20ma
Potentiometer	X	X		
Potentiometer, high accuracy		X		
Thermistor			X	
Thermocouple	X			
Load Cell		X		
Pressure Transducer		X		
Pyranometer	X			
RTD			X	
0-<+5VDC	X			
+/-2.5VDC	X			
4-20ma				X

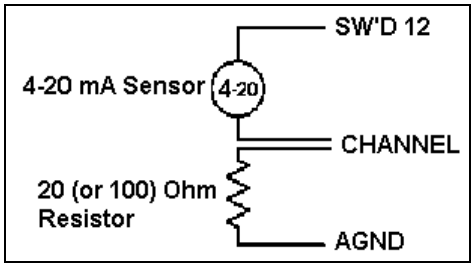
Examples of resistive sensors are potentiometers that are found in many wind direction, gate opening, and position sensors. Other resistive sensors compatible with the 8310 are thermistors and thermilinear sensors (for temperature) and pressure sensors. Sutron uses a +2.5V reference voltage for these resistive devices and reads the voltage on a 0-5 volt scale with a 16 bit converter. The sensor should have a resistance of at least 500 ohms and have enough change in

resistance to show significant changes in the resulting output voltage.

Pressure sensors or strain gauge sensors connect as a differential input using two analog channels. These sensors are powered off VREF and GND and typically have an output of between 5 and 50mV. The accuracy of these measurements is 0.0025mV.

Powered sensors normally have circuits that run off +5V or +12V and have an voltage or current output. Examples of these sensors are some humidity, temperature, water quality, flow meters and pressure sensors. These sensors will use the +12 from the 8310 (switched or directly from the battery) or the +5 (switched or always on).

If the sensor has a current output, such as a 4 to 20 ma sensor, the output needs to pass through a resistor so a voltage can be measured. NOTE: An internal 100 ohm resistor is automatically provided, from the input to analog ground, for making these measurements on channels 1 and 2. To make current reading on other channels, an external resistor must be wired up as shown below. An important limitation of powered sensors is that the ground line of the output needs to be common with the power ground.



Self powered sensors have a battery or require no power to operate. The most common example of a self-powered sensor is a pyranometer. Self powered sensors can operate with the 8310 as long as the sensor ground can be connected to the 8310 ground. The pyranometer would connect to any of the analog inputs of the 8310 and would use the 78mV input scale.

Digital Inputs

The 8310 counter circuits can be programmed to be either event counters totalizing the counts that are received or frequency counters. In either case, the 8310 expects to see a 0 to 5 volt signal from the sensor. Sensors compatible with the 8310 counter/frequency

Counter/Frequency Sensors

The 8310 counter circuits can be programmed to be either event counters totalizing the counts that are received or frequency counters. In either case, the 8310 expects to see a 0 to 5 volt signal from the sensor. Sensors compatible with the 8310 counter/frequency circuits are tipping buckets, wind sensors with amplified speed output. Tipping buckets have a simple switch inside that closes momentarily when the collector is emptied. This works with the 8310 because the counter/frequency inputs have a pull-up resistor. When the switch closes the circuit is pulled to ground which causes the swing from 5 volts to 0 and back to 5.

When used as counters, the circuits count up to 4294967295 and then roll over to 0. A clear

counter command will also cause the accumulator to reset to 0.

When used to make frequency measurements, the 8310 counts the number of pulses it sees in a user set period to determine the frequency. The minimum frequency depends on the period selected. A period of 1 second can measure a minimum of 1 hz. A period of 500ms can measure a period of 2 Hz. The maximum frequency is 8KHz.

Shaft Encoder (Quadrature) Sensors

The digital inputs are compatible with quadrature shaft encoders manufactured by Sutron and others. A quadrature sensor is one that uses two signal wires to code 4 states. A quadrature sensor connects to the same terminals that can be used for counter and frequency measurements. When you select a quadrature sensor, the 8310 reprograms its input circuitry to handle the input as a quadrature rather than a frequency. When selected for an encoder, you cannot use the same terminals for frequency/counter inputs.

Quadrature sensors generally require 4 wires: +12 to sensor, GND, signal 1, signal 2. The maximum speed supported by the 8310 is 4Khz. This equates to 40 revolutions per second (RPS) on a 400 count/turn encoder or 160 RPS for a 100 count/turn encoder.

SDI sensors

SDI 12 is an interface standard for sensors. The intent of the SDI standard is to minimize the difficulty of interfacing the different types of equipment available from different manufacturers, to various data recorder manufacturers' products. SDI allows you to connect up to 10 sensors with as many as many as 9 parameters each. The interface is implemented using three wires: ground, +12V and a bi directional data line. Examples of SDI sensors are shaft encoders, pressure sensors, water quality monitors, and analog expansion modules. The list of SDI 12 sensors is growing all the time.

SDI sensors connect to the 8310 using the SDI-12 terminations G (Ground), + (12VDC) and D (Data). On the 8310, there are two sets of SDI-12 connections for convenience. They are both connected to the same SDI-12 port.

The 8310 protects the SDI +12V line with a thermal, self resetting fuse.

You do need to be careful how you schedule the SDI sensors to be read. Many SDI sensors take a second or two to read; however, there are SDI sensors can take up to 180 seconds to read. Keep in mind the performance of the sensor you are connecting to make sure you do not set the 8310 to measure it more frequently than it can. If you do select a schedule that is too fast for the sensor, you could end up with data missing in the Log.

Hint: you may want to use the SDI C command to make a concurrent measurement of several sensors to help improve performance.

Inputs and Input Connections

As you setup a measurement, you will be asked to define the type of the input and the connection you want to use. With the type and connection defined, the software will display some details of the connections in /diagnostics/inputs.

AIOx:y	x is the analog module number (1 if there are no external modules attached) and y is the input channel.
DIOx:y	x is the digital module number (1 if there are no external modules attached) and y is the input channel.
SDI xy	x is the SDI address and y is the command

Note that some inputs such as a differential analog signal or quadrature, require connection to two adjacent channels.

Grounds

The 8310 has three different grounds on the protection/termination board: analog, digital and chassis.

The analog grounds are labeled with AGND (B1, B5, B9, B12, B15). The analog grounds are tied together on the protection/termination board and then the signal takes a separate path to the A/D converter where it is tied to digital ground.

The digital grounds are labeled GND and are wired internally all together from the A, C and D terminal strips.

The Chassis Ground is a lug or wire that comes off the protection/termination board. All the surge protection devices connect to the Chassis Ground. The internal metal plates are also connected to the Chassis Ground. There is a maximum of 100 ohms between the Chassis Ground and digital ground.

Sensor Setup Examples

The following examples show the details of the 8310 setup for some common sensors.

Shaft Encoder (Quadrature)

Wiring

Quadrature sensors generally require 4 wires, with connections as follows:

Sensor Wires	Function	Connection
Red	Power	Prot +12V (C10)
Black	Ground	Prot Gnd (C9)
Blue	Signal 1	Digital Input IN1 or IN3*
Green	Signal 2	Digital Input IN2 or IN4

*Use either pair of digital inputs: 1&2 or 3&4.

Measurement Setup

The following setup is for the Sutron model 5600-0530 Shaft Encoder.

Field	Value
InputType	QuadSE
Module	1
Channel	Digital Input port number where Signal 1 is wired
Circumference	Foot
Counts per turn	100
ClockwiseRotation	Yes
QuadSE Units	Feet
SwitchedPwr	None
Processing	Slope-Offset
Slope*	1
Offset	0
Cal Slope	1
Cal Offset	0

*Output value is already converted into either feet or meters (chosen in the QuadSE Units field), so Slope is typically 1.

Wind Sensor (with amplifier Circuit)

Wiring

The following setup is for the Sutron model 5600-201 Wind Sensor. Note that the sensor must

have the amplifier circuit – the model 5600-0200 without the amplifier cannot be used with the 8310.

Sensor Wires	Function	Connection
Red	Power	Prot +12V (C10)
Black	Ground	Prot Gnd (C9)
Green	Analog Signal for Direction	Analog Input (any)
White	Analog Reference for Direction	Analog Input VREF
Brown	Digital Signal for Speed	Digital Input (any)

Measurement Setup

A common measurement setup for wind sensors is to use a vector average (see VectAve in Chapter 4), so both the speed and direction are involved in this measurement setup.

Field	Value
MeasType	VectorAverage
M1.I1: Speed InputType	Frequency
Module	1
Channel	Digital Input port number where Speed signal is wired
PeriodMS	200
TakeTwoReadings	Yes
SwitchedPwr	None
Processing	Slope-Offset
Slope	Choose: 0.0980 (m/s) 0.2192 (mph) 0.3216 (fps) 0.1904 (knots) 0.3528 (km/hr)
Offset	0
Cal Slope	1
Cal Offset	0
M1.I2: Dir InputType	Voltage
Module	1
Channel	Analog Input port number where Direction signal is wired
Differential	No
FullScale	0-5V/+-2.5V
SettlingTime	100
FilterNotch	60

SwitchedPwr	None
Processing	Slope-Offset
Slope	142
Offset	0
Cal Slope	1
Cal Offset	0

Air Temperature/Relative Humidity

Wiring

The following setup is for the Sutron model 5600-0315 Air Temperature and Relative Himidity Sensor.

Sensor Wires	Function	Connection
Green	Power	Prot +5V or Prot +12V
Grey	Ground	Prot Gnd
White	RH Analog Voltage	Analog Input (any)
Brown	Temp Analog Voltage	Analog Input (any)

Measurement Setup

The 5600-0315 AT/RH sensor outputs two analog voltage signals between 0 and 1 volts. With a range of -40 to 60 °C, it follows that the temperature measurement has slope of 100 and an offset of -40. The relative humidity measurement, having a range of 0 to 100%, has a slope of 100 and offset of 0. As these are two separate measurements, they each need their own measurement set up. Alternatively, you could use the DewPoint measurement type and incorporate them into a single measurement, as seen in the DewPoint section.

Temperature Setup

Field	Value
InputType	Voltage
Module	1
Channel	Analog Input port number where Temp signal is wired
Differential	No
FullScale	0-5V/+-2.5V
SettlingTime	100
FilterNotch	60
SwitchedPwr	None
Processing	Slope-Offset
Slope	100
Offset	-40

Relative Humidity Setup

Field	Value
InputType	Voltage
Module	1
Channel	Analog Input port number where RH signal is wired
Differential	No
FullScale	0-5V/+-2.5V
SettlingTime	100
FilterNotch	60
SwitchedPwr	None
Processing	Slope-Offset
Slope	100
Offset	0

Cal Slope	1
Cal Offset	0

Cal Slope	1
Cal Offset	0

DewPoint

Wiring

Use the same sensor and wiring as in the previous AT/RH example.

Measurement Setup

This is much the same as the AT/RH example, but by choosing the measurement type as DewPoint, you can have outputs of AT, RH and dew point, all incorporated into one single measurement.

Field	Value
MeasType	DewPoint
TempUnits	Choose Celsius or Fahrenheit. Applies to both input AT and output dew point temp.
AT InputType	Voltage
Module	1
Channel	Analog Input port number where Temp signal is wired
Differential	No
FullScale	0-5V/+-2.5V
SettlingTime	100
FilterNotch	60
SwitchedPwr	None
Processing	Slope-Offset
Slope	100
Offset	-40
Cal Slope	1
Cal Offset	0
RH Input Type	Voltage
Module	1
Channel	Analof Input port where RH signal is wired
Differential	No
FullScale	0-5V/+-2.5V
SettlingTime	100
FilterNotch	60
SwitchedPwr	None
Processing	Slope-Offset
Slope	100
Offset	0
Cal Slope	1
Cal Offset	0

Thermistor

Wiring

Measuring resistance with the 8310 requires an additional reference resistor. The wiring of a

thermistor setup is shown above, with the reference resistor between VREF and the Analog Input. Be sure to use a reference resistor with a tight enough tolerance to achieve the accuracy in temperature you desire.

Measurement Setup

Converting the thermistor resistance to temperature is typically done with the Steinhart-Hart equation, shown below. T is temperature in Kelvin, R is the thermistor resistance in Ohms, and A, B, and C are constants corresponding to the thermistor, usually supplied by the vendor. Alternatively, if the vendor supplies a table of resistance vs. temperature, use a Lookup Table for processing.

$$T = \frac{1}{A + B\,ln(R) + C[ln(R)]^3}$$

Field	Value
InputType	Resistance
Module	1
Channel	Analog Input port number where Signal 1 is wired
Differential	No
FullScale	0-5V/+-2.5V
Resistor	Resistance value, in Ohms, of **reference** resistor
SettlingTime	100
FilterNotch	60
SwitchedPwr	None

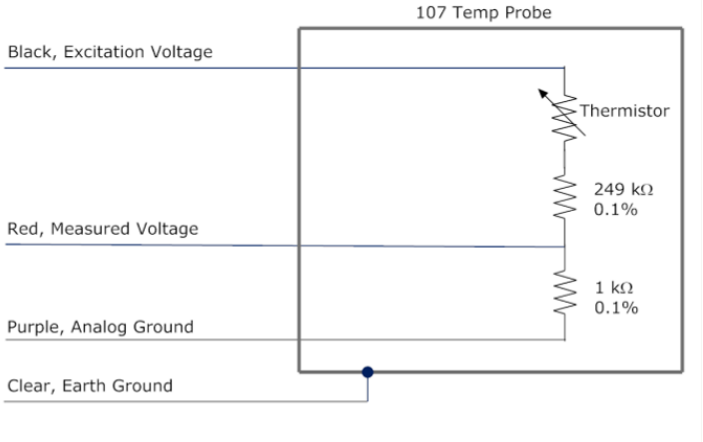
Processing	Steinhart-Hart
A	Steinhart-Hart coefficients corresponding to thermistor
B	
C	
Cal Slope	1
Cal Offset	0

Fuel Temperature Probe

A "fuel temperature" sensor is used to monitor the temperature of surrounding trees by measuring the temperature inside a standard wooden dowel. The Campbell Scientific CS205/107 Fuel Temperature probe is the example shown here. It utilizes Campbell Scientific's model 107 temperature probe which uses a thermistor with a slightly different setup than normal thermistors. It has two internal resistors plus the thermistor. Since it already has a reference resistor inside the probe, there is no need for an extra reference resistor shown with other thermistors setups.

Wiring

A schematic of the 107 Temperature Probe and the necessary connections are shown below.



Sensor Wires	Function	Connection
Black	Excitation voltage	Vref
Red	Analog Voltage	Analog Input (any)
Purple	Analog Ground	AGND
Clear	Earth Ground	Earth Ground

Measurement Setup

Field	Value

InputType	Bridge
Module	1
Channel	Analog Input port number where Analog Voltage is wired
Differential	No
FullScale	78mV
SettlingTime	100
FilterNotch	60
Has Vexcite+ Sense	No
SwitchedPwr	None
Processing	Invert
Cal Slope	1
Cal Offset	0
M#.O1: MeasName	Right arrow into the output setup
Field	**Value**
Processing	Add Slope-Offset
Slope	1000
Offset	-250000
Add Processing	Steinhart-Hart
A	8.271111e-004
B	2.088020e-004
C	8.059200e-008

This Campbell Scientific temperature probe has an additional resistor in series with the thermistor an therefore requires additional processing steps to extract the thermistor resistance Rt.
Rt = 1000 * (Vx/Vo) – (249000 + 1000)

The result of a bridge measurement is Vo/Vx, that is, the voltage output (analog input to the 8310) divided by the excitation voltage (Vref). Therefore the first processing step utilized is "Invert" in order to obtain Vx/Vo. Additional processing is then added to the output. Adding "Slope-Offset" processing with a slope of 1000 and an offset of -250000 finishes the calculation of Rt.

An additional processing step, Steinhart-Hart, is then applied to convert the resistance to temperature in degrees C. The Steinhart-Hart coefficients to be utilized are:
A = 0.0008271111
B = 0.000208802
C = 8.0592e-008

If the desired units of temperature was degrees F, then it would be possible to add another Slope-Offset processing step with a slope of 1.8 and an offset of 32 in order to convert the degrees C to degrees F.

Barometric Pressure Sensor

The following setup is for the Sutron ACCUBAR 5600-120 barometric pressure sensor.

Wiring

Sensor Wires	Function	Connection
Barometer Terminal block terminal 4	Power	SDI-12 PWR
Barometer Terminal block terminal 5	Ground	SDI-12 GND
Barometer Terminal block terminal 6	Data	SDI-12 DATA

Measurement Setup

The ACCUBAR 5600-120 is an example of an SDI (Serial Digital Interface) device. It not only takes measurements, but it processes them internally and sends data to the 8310 with units already assigned. Since it does its own processing, the user must give instructions to the ACCUBAR (through the 8310) on how often to take measurements and what units to deliver them in. Below, you will find the commands required for a very basic setup, but for a full explanation of SDI operations see the ACCUBAR manual.

Address

To set up a measurement, first find the address of the ACCUBAR. This address can be changed, but the factory default is 0. If connecting more than one SDI device, they must each be assigned their own unique address. To communicate with the ACCUBAR, enter the menu at Diagnostics/SDI Tools. Select Find SDI Devices, and it should return the address of the sensor. If connecting more than one SDI device, change the address by selecting Send SDI-12 Comand, and enter the command 0An! in the Send SDI-12 Command field, where "0" is the current address and "n" is the new address you wish to assign to the ACCUBAR. As a standard format, every command begins with the device address and ends with an exclamation mark.

Take Measurements

Taking measurements is a two step process. First, send the measurement command aM! (where "a" is the address). The ACCUBAR will return a value in the form of "atttn" where "a" is the address, "ttt" is the amount of time (in seconds) the ACCUBAR needs to make the measurements, and "n" is the number of measurement values it will return to the 8310. After waiting at least "ttt" seconds for the ACCUBAR to collect and process the measurements, request the data with the command aD0! where "a" is address. (Note: 0 is the number zero, not the letter O.)

The measurement will be delivered in the format of "avn", where "a" is address, "v" is the value, and "n" is a number that corresponds to a set of units, as shown below. For example, "0+101.33+2" would mean that the device at address 0 measured the pressure to be 101.33 kPa.

N value	Corresponding Units
0	mB or hPa

1	Inches Hg
2	kPa
3	mmHg
4	Atm
5	psia
9	User entered units

Setting Measurement Preferences

To change the units or decimal places of the measurements, use the command aXUP+n+d! where "a" is address, "n" is the units desired (same values as in previous table), and "d" is the number of decimal digits desired.

To set the sampling duration, use the command aXT+t! where "a" is address, and "t" is the number of seconds the over which samples will be taken and averaged. Unlike other, non-SDI, sensors where a SamplingInterval is chosen by the user in the measurement setup menus, the ACCUBAR uses only this one input of "t" for sampling duration, and it chooses its own frequency of sampling.

Field	**Value**
InputType	SDI
SDIAddress	0
SDICommand	M!
SDIParam	1
SwitchedPwr	None
Processing	Slope-Offset
Slope	1
Offset	0
Cal Slope	1
Cal Offset	0

Now that the ACCUBAR is configured for making measurements with the correct units and averaging time, add a new measurement in Station Setup/Measurements, and complete the measurement setup there. Given the setup below, the 8310 will send the command 0M! to the ACCUBAR at every sampling time.

IMPORTANT: The *Interval* chosen in measurement setup must exceed the amount of time it takes for the ACCUBAR to return with data after a 0M! command is issued.

Load Cell

Wiring

Many load cells and pressure transducers use this simple four-wire connection. The setup, which uses the difference between two analog voltages, will work for any transducer that uses strain gages and an internal wheatstone (4-wire) bridge.

Sensor Wires	Function	Connection
Red	Power	VREF
Black	Ground	AGND
Green	Analog Signal 1	Analog Input AN1 (B2)*
White	Analog Signal 2	Analog Input AN2 (B3)

*Use any pair of analog inputs: 1&2, 3&4, 5&6, or 7&8.

Measurement Setup

For this measurement, use the Bridge input type, which returns a ratio of the difference between the two measured voltages to the excitation voltage:

$$Bridge\ Voltage\ Ratio = \frac{V_2 - V_1}{V_{ref}}$$

Convert this ratio to a load by following the Slope and Offset calculation example below.

Field	**Value**
InputType	Bridge
Module	1
Channel	Analog Input port number where Analog Signal 1 is wired
Differential	Yes
FullScale	78mV
SettlingTime	100
FilterNotch	60
SwitchedPwr	None
Processing	Slope-Offset
Slope	Calculate slope of sensor
Offset	Calculate offset of sensor
Cal Slope	1
Cal Offset	0

Slope and Offset Calculation Example

Given the following information (supplied by the sensor's vendor), calculate the slope and offset to convert an input of the Bridge Voltage Ratio to an output of pounds.

Full Scale Load or Capacity = 50 lb

Full Scale Output = 3 mV/V (An identical statement from the vendor would be "an output of 15 mV given an excitation of 5 Volts."

Zero Load Output = -0.134% of Full Scale (If given, this is found on a calibration sheet.)

A Full Scale Output of 3 mV/V means 3 mV will be measured given a 1 volt excitation. Slope is the Full Scale Load divided by the Full Scale Output, with a unit converstion from millivolts to volts.

$$Slope = \frac{50\ lb}{3\frac{mV_{measured}}{V_{excitation}} \times \frac{V_{measured}}{1000\ mV_{measured}}} = 16666.67\frac{lb}{\frac{V_{measured}}{V_{excitation}}}$$

Multiply the Zero Load Output by the Full Scale Load to determine the offset:

$$Offset = -0.00134 \times 50lb = -0.067\ lb$$

Together, they make the equation:

$$Load\ (lb) = 16666.67\left(\frac{lb}{\frac{V_{meas}}{V_{exctr}}}\right) \times Bridge\ Voltage\ Ratio\left(\frac{V_{meas}}{V_{exctr}}\right) - 0.067\ (lb)$$

Tipping Bucket (Total Accumulation)

Wiring

A tipping bucket rain gauge should be connected with one lead to digital ground and the other to digital input 1, 2, 3, or 4. It does not matter which lead connects to ground and which connects to the input.

Measurement Setup

Note this setup will never reset the rain, it is a total accumulation.

Field	Value
InputType	Counter
Module	1
Channel	Digital Input port number where tipping bucket is connected
ResetCount	No
FilterValue	3 (see Counter measurement type in Chapter 4)
SwitchedPwr	None
Processing	Slope-Offset
Slope	Slope of sensor, inches or mm water per tip
Offset	0
Cal Slope	1
Cal Offset	0

Tipping Bucket (Hourly and Daily Rain)

Wiring

A tipping bucket rain gauge should be connected with one lead to digital ground and the other to digital input 1, 2, 3, or 4. It does not matter which lead connects to ground and which connects to the input.

Measurement Setup

Note this setup will record hourly and daily rain, it does this by resetting the count every hour and accumulating those hourly readings every day. Setting the daily rain to use a "reference" ensures the hourly rain measurement has completed before using the value. Also take note,

since the readings in the hourly are already scaled from counts to engineering units, the daily accumulation does not need to do any more scaling.

Hourly Setup

Field	Value
MeasName	HRRAIN
Measurement Type	Instantaneous
Measurement Interval	01:00:00
Measurement Time	00:00:00
InputType	Counter
Module	1
Channel	Digital Input port number where tipping bucket is connected
ResetCount	**YES**
FilterValue	3 (see Counter measurement type in Chapter 4)
SwitchedPwr	None
Processing	Slope-Offset
Slope	Slope of sensor, inches or mm water per tip
Offset	0
Cal Slope	1
Cal Offset	0

Daily Setup

Field	Value
MeasName	DAYRAIN
Measurement Type	Accumulate
Measurement Interval	24:00:00
Measurement Time	00:00:00
SampleInterval	01:00:00
InputType	Reference
Reference	Mx:O1: HRRAIN
SwitchedPwr	None
Processing	NONE
Cal Slope	1
Cal Offset	0

Pressure Transducer

A pressure transducer operates identical to the load cell, described previously.

Chapter 7: How To...

This chapter gives specific examples of how to use the 8310. The examples are meant to match the common situations you will encounter. They are also useful to teach you features of the 8310.

Compute the Slope and Offset for a Sensor

Most sensors produce an analog output or frequency. 8310 measurements report the values in the units of volts or Hz unless some action is taken to scale the value into its final units. The slope and offset are used to perform this scaling. As long as your sensor is a linear sensor, slope and offset can be used to scale it. (If you have a non-linear sensor and want the 8310 to do the computation, you will need to use the BASIC capability of the 8310). A linear sensor is one that has output that can be graphed as a straight line. Examples of linear sensors are:

tipping bucket
shaft encoder measuring water level
some temperature sensors
some pressure sensors
wind speed/wind direction.

Examples of non-linear sensors are:

most thermistors,
shaft encoder measuring gate opening
stage/discharge computations.

Whenever the 8310 takes a sample or measurement and has the processing set to Slope-Offset, it applies the equation:

value = raw_value * slope + offset.

With slope = 1 and offset = 0 the final value is equal to the raw_value.

To determine the slope and offset for your sensor, you will need to know the sensor output for two different points. This information is typically available on the sensor's data or calibration sheet. These two points are then used to compute the slope and offset. The two points are represented as (x1, y1) and (x2, y2) where x is the voltage or raw reading and y is the corresponding value.

The slope and offset are then computed from these two points as follows:

slope = (y2-y1)/(x2-x1)

offset = y1 - x1*slope,

as long as the "x" values are in the same units as the raw_value.

Consider a wind direction sensor. The sensor is a potentiometer excited by 5 volts. The output at 0 degrees is 0 volts and the output at 360 degrees is 5 volts. (x1, y1) = (0, 0) and (x2, y2) = (5, 360). The slope would be (360-0)(/5-0) = 72 and the offset would be 0 - 0 * 72 = 0.

Some further examples will help demonstrate the use of these equations. Remember that the x values are the raw values (volts, hz, counts etc.) and that the y values are the final values.

A 5 psi pressure sensor has a calibrated span of 36.22 millivolts and an offset of -1.22 mv. This example gives all the information necessary, but is in a different form. We know that (x1, y1) = (-1.22, 0). We know that Y2 is 5 psi but they do not give us the X2 value. Instead they give the span from which we can compute X2 knowing that X2 = Span + X1. Or we can just use the span as it is = X2 - X1. So we have Slope = (Y2-Y1)/(X2-X1) = (5-0)/0.03622) = 138.04 and offset = 0 - (-0.00122) * slope = 0.168. Notice that we converted the millivolts to volts before using the values in the equation because the x values must be in the same units as the raw reading.

Let Calibrate Compute the Slope and Offset for you

The 8310 calibrate function built into the 8310 can compute the slope and offset for you. In order to use the calibration function, you will need to have an independent measurement for the input or a way to force the input to a known value. Calibration process supports both single point calibrations where only the offset is determined or two point calibrations where both the slope and offset are determined. The calibrate function is available from any menu displaying an input such as in Station Setup/Measurements or Diagnostic/Inputs Calibration.

Printing the Setup

To print an 8310 setup, use the LIST command.

Understand the Measurement process

The 8310 uses the fields entered in Station Setup/Measurements to control when it measures and averages data from sensors. This section gives a more complete description of how all the measurements are made.

- The 8310 uses separate processes to make each measurement in the system.
- Multiple processes can be running in parallel so that all measurements are made as efficiently as possible.
- The measurement process starts at the time designated by the MeasTime and MeasInterval.
- The process will first will use the switched power settings to see if the sensor needs to be turned on and warmed up in order to make the measurement. Warmup times add to the time needed to complete the measurement.
- Processes then gain access to resources (like the analog module) on a first come-first serve basis.
- Processes will have to wait for each other if they both need the same resource.
- If one process needs the identical measurement as another process (same config and time), that measurement is shared between the processes.
- Measurements are time-stamped with the time of the measurement even though that measurement may have taken several seconds (or even minutes) to be made.

When averaging, the processing implements a few additional steps:

- The system times the sampling so the last sample is taken at the measurement time.
- The diagram in Figure 1 Sampling and Averaging shows the details of when the samples are taken.

Sampling will start as soon as recording is turned on and the time is within the desired sampling period. When it is time to output a measurement, if the system has made fewer than ½ of the desired number of measurements, the data is marked with the "B" status. This can happen because the sampling interval is set too short for the input or the system was started late in the cycle.

Hint: use the "Report Debug" command to see the sequence of events as the system implements the measurement processes.

Understand Alarms and Alarm Transmissions

The 8310 can be set up to detect alarms on sensor values and to make transmissions as a result of an alarm. This section describes alarm detection and notification in detail. Anyone using alarms should make sure they understand the concepts presented here.

The user sets alarm conditions on individual outputs from the ouput's menu. Here's an example, showing a menu with HiLimit, LowLimit, and HiROC alarms defined:

```
Name                    Stage
Units
RightDigits                2
Processing          ►      None
Display                 Yes
M1.O1: Log        \Flash Disk\data.log
LoggingInterval         00:15:00
RecordID                <None>
HiLimit Alarm       Threshold = 5
HiROC Alarm         Threshold = 10
LowLimit Alarm      Threshold = 0
Add Alarm
Delete Alarm
AlarmDeadband              5
AlarmLogging            InAndOut
IsSSPCurData               Yes
SSP Settings        ►
Iridium COM2:       ►   Iridium Settings
End M1.O1: Stage
```

The 8310 tests for alarms each time the measurement produces an output. An output enters alarm when the output value extends outside the specified limit. An output enters hi-limit alarm when the output value exceeds the *HiLimit Threshold*. An output enters low-limit alarm when the output value falls below the *LowLimit Threshold*. An output enters hi-ROC (rate of change) alarm when the change in the output value since the reference specified by *HiROCInterval*, exceeds the *HiROC Threshold*. When *HiROCInterval* is *SinceLastTx*, the rate of change is

calculated between the current value and the last value that triggered an alarm transmission. When *HiROCInterval* is *SinceLastMeasurement*, the rate of change is calculated between the current value and the last measured value.

Once in alarm, an output exits the alarm state when the output value returns to within the specified limit by at least *AlarmDeadband*. For example, given a *HiLimit Threshold* of 5 and an *AlarmDeadband* of 1, the output will exit alarm when its value becomes less than 4. Note there is only one *AlarmDeadband* property per output, meaning all alarms for the output use the same deadband.

An output can enter a new alarm state while already in alarm. For example, if you define two hi-limit alarms, say one at 5 and another at 10, the output will enter alarm when its value exceeds 5, and then again if the value exceeds 10. This can be useful for triggering alarm transmissions at more than one hi/low/roc limit.

Add Alarm and *Delete Alarm* are used to add and delete alarms, respectively.

Alarm Logging

The *AlarmLogging* property works in concert with the *LoggingInterval* property to control whether an output is logged in alarm circumstances. When *LoggingInterval* is set higher than an output's measurement interval, then the measurement that causes an alarm wouldn't be logged if it were a measurement that did not fall on the logging interval. The *AlarmLogging* property gives you a way to log the alarming data, regardless of the value of *LoggingInterval*. When *AlarmLogging* is *InAndOut*, data that causes an output to enter or exit an alarm is logged. When *AlarmLogging* is *Always*, all data while in alarm, and data causing the alarm exit, are logged.

Triggering an Alarm Transmission

You configure the system to transmit on alarm by setting the *TxAlarmMode* property of the associated device to either *TxIn* or *TxInAndOut*. This property is found in the menu belonging to the respective telemetry device. For example, to configure the system to make an alarm transmission over Iridium when an output goes into alarm, first configure the output to alarm as desired. Then enter the output's Iridium sub-menu and set the *TxAlarmMode* property to either *TxIn* or *TxInAndOut*.

When *TxAlarmMode* is *TxIn*, a transmission occurs when the output enters alarm. When *TxAlarmMode* is *TxInAndOut*, a transmission occurs when the output both enters and exits alarm.

Store and forward and cross device repeating SSP messages

The 8310 can store and forward SSP messages either back out the same port ("smart repeating" or out another port ("cross device repeating". Smart repeating is used in LOS radio systems to send a message to a site which is on the fringe of reception or out of range by using a third site in the middle. For instance if site A cannot reach site C, but site A can reach site B and site B can reach site C - then smart repeating can be used to send from site A to site B and then on to site C.

To set a PCBASE2 master station to use store and forward, set the radio path with the names of

the destination and repeating stations separated by "_". For the previous example, the radio path would be: B_C (read this as to site B then repeat to site C). Multiple repeaters can be specified by chaining them together: B_C_D_E would send a message to B first which would repeat it to C which would repeat it to D which would repeat it to E. One draw back to smart repeating is the hop-delay. Each hop requires time to receive and then retransmit the message. At 1200 baud it may take 10 extra seconds per hop for a long message. Ack delays and response timeouts must be increased proportionally.

An 8310 automatically replies using whatever source the message originated from including all the repeating stations. If you want the 8310 to originate an alarm message using the store and forward capabilities, you must add the names of the repeating stations to the PROTOCOL SETUP/MASTER ID.

Cross device repeating allows a message to be received on one device and repeated out another. This could be from one radio to another or even from a telephone modem to a radio. A radio in the first 8310 card slot would be using device AUX:, a radio in the second slot would use COM:, an external radio connected to the RS-232 port would use TERM:. The syntax for sending a message to site C reachable thru site B's radio in the first slot would be: B_AUX:C (read this as to site B repeated out AUX: to site C).

Under SSP a repeater will never attempt to retry a message, it is the responsibility of either the source or the destination to attempt retries.

Use MODBUS with the 8310

The 8310 supports both Modbus Slave and Modbus Master operation.

Modbus slaves are configured from the Station Setup – Communications menu. The menu reference for serial slave operation is defined in the Station Setup/Communications/COMx MODBUS menu. The menu reference for TCP/IP slave operation is defined in the Station Setup/Communications/ MODBUSTCP menu. Modbus registers are defined within the 8310 by assigning a register number to an output. See the Measurements/Ox/MODBUS menu reference for details.

Modbus masters are implemented in the 8310 using the MBSensor input type, and the MBOut measurement type. The MBSensor input type is used to read values from a Modbus slave device. The MBOut measurement type is used to write values into a Modbus slave device.

Reserved Modbus Registers

Holding registers in the range 1001 –1099 (4:01001 to 4:01099) have been reserved for the purpose of setting and getting 8310 state data, and for controlling the operation of the 8310. The following table identifies the actions that occur when reserved registers 1001 – 1099 are read or written.

Reg #	Register Description	Read	Write
4:01001	Hour of current time.	Returns hour in range 0 – 23.	Sets hour. Use range 0 – 23.

4:01002	Minute of current time.	Returns minute in range 0 – 59.	Sets minute. Use range 0 – 59.
4:01003	Second of current time.	Returns second in range 0 – 59.	Sets second. Use range 0 – 59.
4:01004	Year of current data.	Returns year.	Sets year.
4:01005	Month of current date.	Returns month in range 1 – 12.	Sets month. Use range 1 – 12.
4:01006	Day of current month.	Returns day in range 1 – 31.	Sets day. Use range 1 – 31.
4:01007	Recording status.	Returns 1 to indicate recording is on, 0 to indicate recording is off.	Write 1 to turn recording on, write 0 to turn recording off.
4:01008	Reset unit.	Returns 0.	Write 1 to reset the unit.
4:01009	Transmission protocol.	Returns 0 to indicate RTU protocol. Returns 1 to indicate ASCII protocol.	Write 0 to set protocol to RTU. Write 1 to set protocol to ASCII. The response to this message will be in the original protocol.

Chapter 8: Installation

This chapter describes the factors that must be considered in order to properly install the 8310. The topics covered include environmental protection, power budget, cabling, lightning protection, bench testing and field testing. Use this chapter as a guide as you prepare for your own stations.

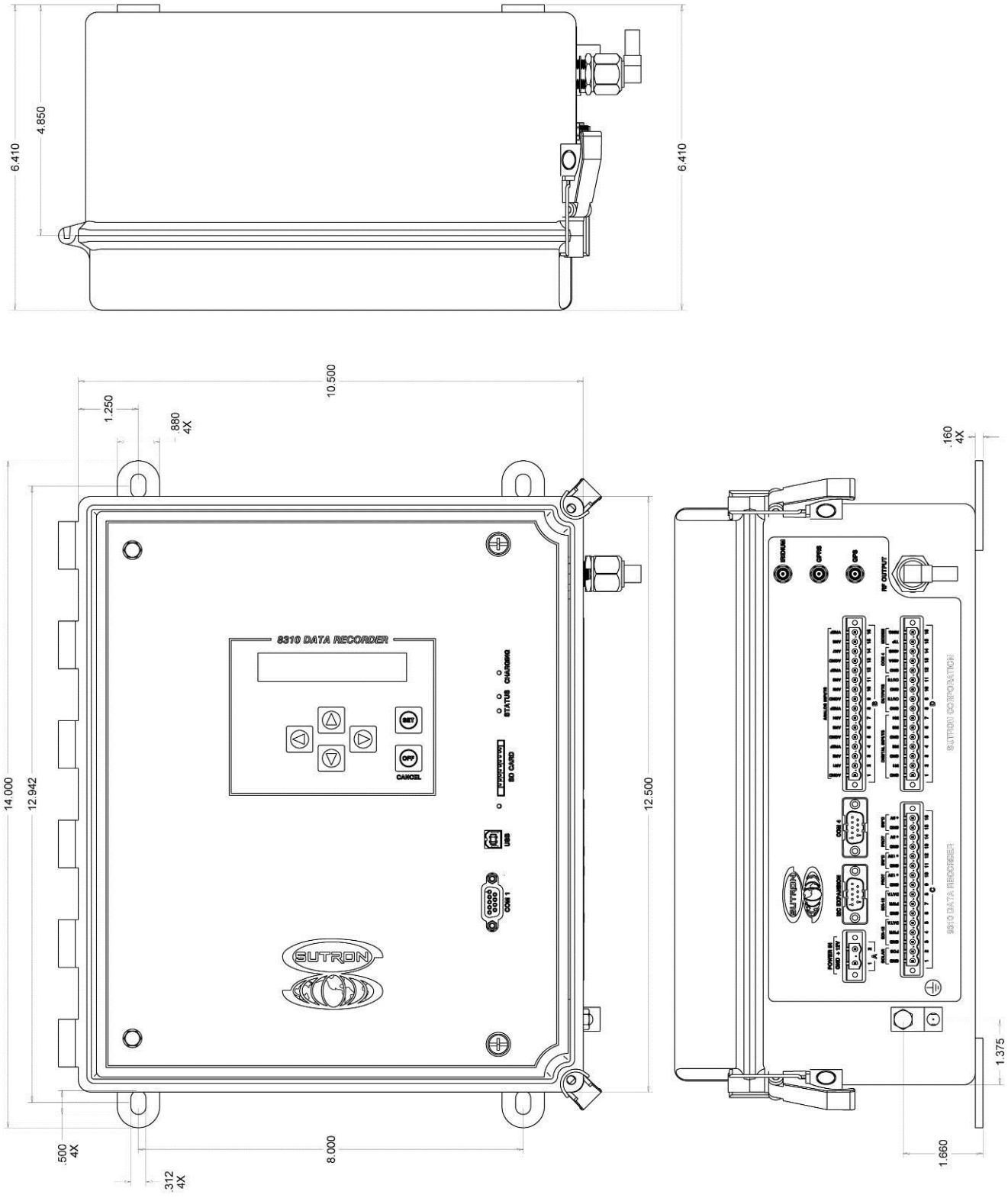
Environment/Enclosure

The 8310 is designed to withstand temperature extremes but should be protected against direct exposure to rain and dust. If you plan to install the 8310 outside, order an 8310-O. This configuration fits nicely into NEMA-4 or IP65 type enclosures available from Sutron and others. If the 8310 is installed inside another structure such as a gage house, then the 8310-N or O can be installed without an additional enclosure. The advantage to using an enclosure even for indoor installations is that the enclosure provides a way of organizing batteries, cables and protecting them from inadvertent handling.

When using an enclosure, it is good practice plan for the cable entrance/exit in the bottom or sides of the enclosure. Avoid cables entering the top of the enclosure as this promotes leaking. For outdoor installations, cables should enter the bottom of the enclosure. Plan on using liquid tight fittings around cables to create a seal around the cable and the enclosure.

A gell-cell type battery may be placed in the same enclosure as the 8310. This type of battery is designed to recapture the gasses that result from charging the battery. Some other batteries however, will release the gasses into the enclosure. If the battery has a vent hole on it then this should be connected to a tube and routed outside the enclosure. If the battery does not have a vent hole and is not a "sealed" type battery, it should be placed outside the enclosure.

The following drawings show the dimensions of the different model 8310s.


6.410
4.850
6.410
10.500
1.250
.880
4X
14.000
12.942
12.500
8310 DATA RECORDER
SET
OFF
CANCEL
STATUS
CHARGING
SD CARD
USB
COM 1
SUTRON
.160
4X
1.375
1.660
.500
4X
8.000
.312
4X


.230
4X

Power Budget

The power budget is an analysis of how much power the 8310 requires. The analysis is required to determine how long the 8310 will operate from the battery without recharging and what size solar panel (or charging source) should be used.

The 8310 uses different amounts of power depending on what it is doing. The only way to come up with the power budget is to determine how much time the 8310 spends in each of its tasks and how much power is used doing each task. The following list shows the power used by the 8310 in some typical tasks. Please note that the consumption is approximate:

Quiescent (basic model): 3 mA
Quiescent GOES: +9 mA
Measuring: +8 mA to + 30 mA depending number of measurements occurring simultaneously.
Transmitting GOES: 3 to 4A depending on Antenna, Satellite, & baud rate
Display ON: +70 ma
LanON or LanAuto with a connection: +21 mA
Downloading log: +32 mA

Note: Most of the items are listed with a plus sign "+" in front of them meaning that they add to the base current. For example, the quiescent current of an 8310-N-S that includes the Satlink GOES module would be: 3+9 = 12 mA.

To find the power needed by a site, add up all the power required by each of the tasks taking into account the percent of time spent in each task. The best way to do this is to make a table (or spreadsheet) listing each of the tasks, current and times as shown below for an 8310-N-S with GOES that collects data every 15 minutes and transmits once every hour.

Task	Current	Percent Time	Average Current
Collecting	8mA	5sec/900 sec 5 seconds to collect every 15 minutes	0.04
Transmitting	3500mA	8sec/3600 sec 8 second tx every hour	7.78
Quiescent	(3+9) =12ma	100% (always)	12
		Total Average Current	19.8 mA
		Total Average Power (current * 12VDC)	238 milliwatts

Remember to add in the power required by sensors.

You can see that we had to estimate the amount of time spent collecting, transmitting as well as the power required for collecting. It is best if you come up with these numbers yourself using actual measurements of the power consumption for an operating 8310. Once you have a value for the average consumption, record it and use it as a reference when troubleshooting a station. A site that shows a marked change in power consumption warrants a closer look.

Note: Remember and use the simple equation:

Power = current * voltage

and keep the units straight. If current is in milliamps (mA) than power is in milliwatts (mW).

Once you have the average power required by the 8310 you are able to make two important calculations. First compute the battery capacity. To do this, divide the battery capacity by the average power needed by the 8310 as follows:

- battery duration = battery capacity/8310 Average Current

Example: Compute the battery duration for a 24 amp-hr battery powering an 8310 with average power consumption of 50 ma.

- battery duration = 24000ma-hr/50ma = 484 hrs

Since you cannot use 100% of any battery the actual duration will be less. We recommend you only plan on using 75% of the capacity of a battery which reduces the actual duration by 25%. In our example, the 484 hrs duration would become 363 hours.

The size of the solar panel needed for the site depends on both the average power needed and the location of the site. As a general rule of thumb, use a panel that provides at least 10 times the average power needed.

Example: Size a solar panel for a site with average current of 50ma.

- Power needed = 10 * (current * voltage) = 10 * (50ma * 12 volts) = 6000 mW

- The minimum size panel should have an output of at least 6000 milliwatts. A 9 watt panel should work just fine.

Note that the internal charger in the 8310 has been designed to handle up to a 20W solar panel. If a larger panel is needed to handle the station load, then an external regulator should be utilized. The full benefit of the larger panel would not be achieved with the internal regulator since it will limit the amount of power that will be passed through to the battery.

For sites with AC power, an AC/DC power supply can be used as the charging source. To fully charge the battery at cold temperatures, the output voltage of the DC supply needs to be at least 15V DC. The required current capability of the AC/DC supply depends upon battery size

and the acceptable recharge time. If the required current is more 2A, then it is recommended that an external regulator be utilized.

Cabling

Many sites have serious problems because of bad cabling. The following points should be considered as you plan and install your cabling:

1. Keep cable length to a minimum. The shorter the run, the less chance of signal degredation.

2. Use shielded cable especially if the run is greater than 75 feet. The additional cost is minimal compared to the cost of logging bad data.

3. Bury the cable when possible. Make sure, however, that the cable used is rated for direct underground burial. If not, conduit should be used to protect the wires.

4. Strip and tin (tinning is another term for soldering.)the ends of the wires that connect to the 8310. If the ends are not tinned, the wires might frey causing a bad connection and potential signal loss.

5. Finally, the most common mistake made when connecting to the 8310 occurs when the insulation is securred instead of the bare wire rusulting in a bad connection.

Surge and Lightning Protection

A major factor in keeping a site fully operational for extended periods of time is proper grounding. Static electricity and other transients from nearby storms or high voltage power lines can cause a variety of problems in the 8310 if the site is not grounded properly. Good grounding is the most important way to protect a site from damage caused by transients and to insure its long-term operation. The guidelines listed should be followed when an installation is performed.

1. Use long ground rods. The idea behind earth grounding is to drive the rods far enough into the ground so the metal comes in contact with the grounds' own moisture. Because of this, exact lenghts of the rods may vary, therefore you must have a good idea of current conditions such as precipitation amounts and ground moisture levels to make the best judgement on the length of the rods. As a general rule of thumb, the longer the better.

2. Use more than one rod. In some instances it may be necessary to create a grounding array of up to four rods all of which are tied together by a heavy gage copper wire (10-12 AWG). Remember to not compromise length for numbers. It is far better to have one 8 ft. grounding rod than four 2 ft.rods.

3. After tying the rods together with copper cable, connect another piece of the copper wire to a rod and bring it inside to be connected to the logger and sensors if necessary. There is a ground lug located on the lower left hand corner of the 8310 which can be used to connect to. When bringing the wire into the gage house or Nema Enclosure, try to keep bends in the wire to a

minimum since lightning tends to follow a straight pathway.

4. At stream gaging stations, do not solely ground to the stilling well. It would appear logical that the best ground one could have would be the river or stream at the site, however, when a close by lightning strike occurs on the water, the transient travels freely through the water, to the metal float, up the steel tape, into the shaft encoder, then finally into the logger. This information has been obtained from various field people who have indicated this being a source of problems, therefore, it is suggested that the earth grounding guidelines listed above be followed and grounding to the stilling well only be used as a last resort.

Bench Testing

A complete station consists of sensors, wiring, 8310, power supplies, communications and setup or programming. Sutron recommends that each station be tested on a "bench" setup (in the office) before it is put in the field. There are countless stories of persons traveling hundreds of miles to install a station who cannot complete the task because of a missing cable, incompatible sensor, or incomplete programming information. The most important lesson from these wasted trips is to "bench" test the system (hardware, sensors and setup) as far as possible before trying to install the station.

A good bench test will connect the actual sensors using the actual cables. Create and follow a wiring diagram for the connection of the sensors. Fill out and use the 8310 setup sheet. As stated in Section 5, the setup sheet is the tool used to specify the details of the 8310 setup. The best place to create the setup sheet is on the bench with as many of the sensors connected to the 8310 as possible.

Most of the commonly used sensors have been interfaced to the 8310 and typical setups for them are located in the "How To" section in this manual. If not, contact Sutron for an Application note that Sutron may have written for the sensor. If by chance you have picked a sensor which we have yet to interface with, our Applications Dept. will do their best to assist in the interfacing. We do ask, if this is necessary, to send us one of the sensors you are trying to use so we may connect it to the 8310 in our lab and develope the appropriate application note.

You will want to activate the station so it makes its measurements, logs data and even transmits. Vary the sensor inputs to make sure that the conversion to engineering units and other processing is correct. If the station is part of a network of stations, set the base station up to handle the data. A common error is that the base station software is not configured properly to receive and process data from the station when it is installed. Then when the base station is setup an error is encountered which requires going to the station to change the setup. Running tests on the bench help to insure that the data from the field stations is handled properly.

If your setup uses alarms, you will want to adjust the sensors to measure at alarm levels. Note how the 8310 handles the alarms to make sure that it is working the way you want.

Test Before you Leave

Chapter 5 gives the basic steps to setting up an 8310. Naturally, after entering the setup and activating the station, you will want to check the station out before you leave. These checks should include at a minimum:

1. View data from each sensor and make sure the values displayed are correct. If not, there may be an incorrect number entered in the "Config Sensors" submenu or there may not be a good connection to that sensor.

2. View logged data for each sensor and make sure the values are correct.

3. Use a DVM to insure the charging voltage is present.

4. Go to the "Inspect System " menu and then to the "Display Status" submenu. Perform a Display Status and verify there are no error messages, tripped failsafe, or any other message which would lead you to believe that something may be wrong with the 8310. Also observe the messages which provide the Transmission (Random and Self-Timed) schedules and make sure the next Tx times are going to occur when you believe they should. Note the number of resets and use this as a reference for later visits.

5a. If you have a GOES unit, it is advisable to perform a forced transmission to ensure proper operation of the Goes transmitter section and verify the external battery has enough capacity to allow a transmission. Make certain when forcing self-timed transmissions, that you transmit into a dummy load to keep from interfering with another DCP. Connect a voltmeter directly to the battery and observe the voltage drop while the transmissions are taking place. If the voltage drops much more then 1/2 of a volt, the battery is suspect and should be changed to avoid future problems. When forcing random transmissions, it is advised to transmit through the antenna and verify your downlink received it before you leave the general location of the site.

5b. If you have a telephone system, have someone dial the station, make sure it answers in the proper mode and communicates the data properly.

5c. If you have a LOS radio system, have the base station poll the station and display the system status to look at communications statistics.

6. Contact the base station to make sure data are being received properly.

7. Make sure the date and time are correct. The time for GOES units should be exact.

8. Make sure the Recording ON message is displayed (or ON&TX) for GOES units.

GOES Antenna Pointing

Refer to the Satlink manual for information on pointing the GOES antenna.

Chapter 9: Retrieving Your Data

This chapter describes the different ways you can use to retrieve data from an 8310. The different ways include SD Cards, PCs, radio communications, telephone communications and satellite communications. Review this chapter to make sure you know all the ways to retrieve data from the 8310.

Introduction

There are many ways to retrieve data from the 8310. This chapter presents all the ways that we know of. You may be able to figure out a few of your own. There are two basic types of readings that the 8310 can communicate: last measured value and logged data. The retrieval of each of these types of data is discussed.

Last Measured Value

The last measured value for a measurement is normally displayed in the Main menu as long as the Display attribute is set to YES. If the value is not displayed there, you can always see all the inputs and outputs in the Diagnostics menu. The last measured value is also available to SSP/VOICE messages as long as the SSP settings for the sensor have Alarm Enable = YES.

Logged Data

Logged data is the most common data retrieved from the 8310. There are the following methods of retrieving logged data:

- 8310 Menus – Logged Data
- 8310 Speech script
- LOS radio -- reply to a Time-Tag Data request
- GOES self-timed transmission -- use the setup fields to control how much data is sent. Use the Alarm/Groups to control which sensors are sent.
- GOES random transmission -- use the setup fields to control how much data is sent. Use the Alarm/Groups to control which sensors are sent.
- Download Log to card. Downloads can start automatically if an SD card is inserted when the display is off. If the display is already on, use the SD card operations menu after inserting the card. An SD card can hold multiple files. The downloaded data is named using the stationname and the date of the data.
- Download log (to terminal/PC). This function is available in the Terminal Operations menu. The function allows either parts of the log or the entire log to be downloaded. The download requires a terminal program running on your PC, such as Hyperterminal, that supports the Y-MODEM transfer protocol (for Windows Vista and Windows 7, Hyperterminal may be downloaded, here: http://www.hilgraeve.com/hyperterminal/).

SD Cards

Using SD Cards

All 8310 data recorders have been designed to use small SD cards. SD cards can be used to retrieve either setup or log data from an 8310. SD cards can also hold setup files eliminating the need to carry a laptop to a station.

See the section titled SD Card Operations for details on using SD cards

Radio Options

External radio support is a standard part of all 8310s. 8310s with the internal radio modem also have additional radio support. The radio support provides the following functions:

- transmit last measured data
- transmit logged data
- upload/download setup
- recording on/off
- set date/time
- change slope and offset
- store and forward message to another station

All communications with the 8310 are done using Sutron Standard Protocol (SSP) which insures error free communications. The communications can be either with a base station or one of Sutron's model 9000 field stations. Other 8310s can also be used as smart repeaters to forward messages to other stations. Sutron has several software products that run on PCs to handle communications.

Enabling External Radio Support

External radio support is enabled through the Setup/Communications menu.

Connecting To An External Modem

Connect the external modem to the COM4 port of the 8310. The following diagram lists the pinouts for the RS-232 port on the 8310. The connector is a DB9-male.

Pin 1 CD
Pin 2 RX
Pin3 TX
Pin 4 DTR
Pin 5 GND
Pin 6 DSR
Pin 7 RTS
Pin 8 CTS
Pin 9 RI

GOES Data

When you have an 8310 with a GOES module, the data can be transmitted over GOES on a self-timed schedule, random/alarm schedule or both. You have complete control over what data is included in each type of transmission and how much data is sent. You also have partial control over the transmission format. The 8310 supports many different formats including standard decimal (also known as SHEF) and binary. Refer to Appdendix D, Telemetry Formats, for more details.

Chapter 10: BASIC

BASIC is a programming language built into the 8310. You can use it to add special equations and processing to sensor data, do different alarm detection and much more. BASIC makes the 8310 flexible to handle custom applications, yet easy to use.

8310 BASIC is derived from Sutron's Xpert BASIC. For a comprehensive language reference, please see "Xpert Basic SLL User Manual.pdf", available for download from www.sutron.com/downloads/manuals.htm.

Basic Introduction

Up until this point in the user manual, you have learned about some of the simpler operating procedures behind the 8310. One of its more powerful yet more complicated functions remains to be covered. This chapter will attempt to explain, in some detail, the BASIC interpreter that has been added to the 8310.

The BASIC interpreter executes user written instructions coded in a custom version of the BASIC language. BASIC supports full floating point expressions, control statements, measurements, logging, alarms, serial I/O, I/O, and much more. Because this subject does require some prior knowledge of the BASIC language, we ask you to proceed only if you feel you have an adequate grasp of the programming conventions of BASIC.

You will find BASIC to be especially useful for special conversions on sensors, smart sampling or logging, special alarm detection, control applications, and custom phone-voice messages, custom GOES formats and more.

8310 BASIC is derived from Sutron's Xpert BASIC. For a comprehensive language reference, please see "Xpert Basic SLL User Manual.pdf", available for download from www.sutron.com/downloads/manuals.htm.

The BASIC language is based on a subset of the BASIC language used on most personal computers. The following are some of the features of 8310 Basic:

- Variable support for integers, floating point numbers, strings, date and time, sensor readings, events, and arrays, including multi-dimensional arrays.
- Global variables and functions can be shared across programs.
- Subroutine and function support.
- Pseudo-compiled code for faster execution and early syntax error detection.
- Excellent support for structured programming concepts by way of FOR, WHILE, and DO control loops, and Select Case statement. Line numbers are supported, but are optional. Line labels are supported.
- No limit on program size, multiple programs are supported.
- Ability to schedule programs to be run on an interval.
- Functions to access the Analog and Digital I/O modules to make sensor measurements.
- Support for alarm and alarm transmissions.
- Support for SSP SendTag and GetTag, as well as generic SSP messaging (RequestMessage, SendMessage and GetMessage).
- Support for reading and writing disk files, serial ports, log files, and sockets.
- Ability to call functions in "C" DLL's.
- Support for run-time error handling.
- Support for TCP/IP communication, including the ability to creating TCP or UDP Web Servers.
- Support for dynamic web page creation, including support for HTML forms (CGI).

- Multi-threaded support, including independent threads of execution, critical sections, and event variables.
- Ability to run programs even while recording is turned off.
- Create custom input types
- Create custom processing steps
- Create custom measurements

Differences Between 8310 and Xpert BASIC

On the 8310 and 7310 OEM units (non-NEMA enclosures), the DIO outputs are named "DIO1" and "DIO2", whereas on the 8310 NEMA enclosure, the outputs are named "DIO5" and "DIO6". Please note: to address these channels via BASIC routines (e.g., the Digital statement), specify module 1, channels 5 and 6.

Steps to Using Basic Programs

Create the Basic program on a PC using a text editor, and save it with a .bas extension.

Load the Basic program into the 8310.

Toggle recording OFF then ON, to cause the new program to be compiled (any syntax errors will be detected at this point), or you can compile a program from the Diagnostics Menu/Basic Status option.

Creating a Simple Program

Here are some examples of some simple programs…

Example 1. Measuring, processing, and logging an A/D channel using Basic

The following program will measure, convert, and log an air temperature sensor connected to the AN1 input.

```
Interval = TimeSerial(0,1,0)  : ' Log every minute
Offset = TimeSerial(0,0,0)    : ' On the minute

Const ADModule = 1
Const ADChannel = 1

Public Function MeasureAirTemp(Parm)
   ' Set the return value to 0 to keep re-scheduling
   MeasureAirTemp = 0
   ' Measure A/D channel the sensor is connected to
   Volts = Ad(ADModule, ADChannel)
   ' Now convert from raw voltage to degrees C
   degC = -20 + 20 * Volts
   ' Now convert to degrees F
```

```
   degF = degC * 9/5
   ' Log the data to the Data.log under the name AirTemp
   Log "Data", Now, "AirTemp", degF, "G", "deg F"
End Function

' Measure and log AirTemp every minute
StartTask "MeasureAirTemp", 0, Offset, Interval
```

Example 2. Custom GOES formatting

Basic may be used to create custom GOES messages. In this case, we're going to append a raw voltage measurement of AN1 in standard decimal format to the end of the message as defined by the setup. In addition you must inform the setup that you wish to use custom formatting. You do this by selecting your function from the Station Setup/Basic menu with the "SelfTimed Formatter" option.

Basic offers precise numeric to text conversion with the Format() function, and can also prepare data in the GOES 6-BIT format with the Bin6() function, or the ARGOS format with the Bin() function.

```
Public Function SELFTIMED_FormatGOES
   ' Append the raw voltage measurement of AN1 to the end
   SELFTIMED_FormatGOES = SELFTIMED_FormatGOES & " :AN1 0 #60 " &
Ad(1,1)"
End Function
```

Example 3. Sending a TCP/IP transmission

Communicating over TCP/IP can be very simple in Basic. It involves opening a URL as if it's a file, then using the standard I/O functions to read or write data. In this example, we're going to send a simple UDP message to a fictitious server on the network.

```
Sub SendUDP
   F = Freefile
   Open "server.mycompany.com:610,UDP" As F
   Print F, "The current A/D value is: "; Ad(1,1)
   Close F
End Sub
Call SendUDP
```

For more detailed information on BASIC refer to the separate BASIC manual.

Example 4. Custom Input

Basic allows you to define your own input type using a basic function. All functions you've written and loaded onto the Flash Disk that take one argument and have the prefix "INPUT_" in their name are candidates, and will show up as selectable input types when creating a measurment.

```
' Demo of using a basic function as a Measurement Input.
' Function has "INPUT_" prefix in name, and receives a
' Sensor Reading arg with ".Time" set to scheduled time,
' and ".Name" set to the measurement and input names, e.g.,
' "Stage" or "Wind:WS" (only inputs of measurements with
' more than one are named).
'
' Sensor Reading fields we can change include:
```

```
'     .Time, .Name, .Data, .Quality,
'     .Units, .Alarm, and .Digits
'     (however, .Units should be set on output)

Const POLL_CMD = "poll" + Chr(13) + Chr(10)
NumBytes = 0
Response = ""

Public Function INPUT_RS232(sr)
   sr.Quality = "B"
   On Error Resume Next
   Port = FreeFile
   Open "COM2:" As Port
   If Err = 0 Then
      SetPort Port, 115200, 0, 8, 0, 1  ' 115200,N,8,1,h/w
      SetTimeout Port, 1.0
      FlushInput Port
      NumBytes = WriteB(Port, POLL_CMD, Len(POLL_CMD))
      NumBytes = ReadB(Port, Response, 100)
      If Err = 0 Then
         sr.Data = Response
         sr.Quality = "G"
      End If
      Close Port
   Else
      ErrorMsg "RS232: Port open failed"
   End If
   INPUT_RS232 = sr
End Function
```

Example 5. Custom Processing Step

Basic allows custom processing steps to be created that can be applied to any input or output. The step can only be a function of a single input and may only produce a single output, however other values may be incorporated in to the step by accessing tags or making direct readings. For instance, this step can be used to adjust a Wind Direction sensor by applying a compass correction:

```
REM Compass.bas – accepts a wind speed as the input
REM and returns the speed corrected for compass bearing
REM
REM Sensor reading fields we can change include:
REM    .Time, .Name, .Data, .Quality,
REM    .Units, .Alarm, and .Digits
REM
Public Function PROC_Compass(i1)
   o1 = i1
   REM Assume the compass is connected up to input AIO1
   REM and produces 0V = 0 deg, and 5V = 360 deg
   CompassReading = Ad(1,1) / 5.0 * 360.0
   o1.Data = i1.Data + CompassReading
   REM Correct for a direction above 360 deg
   If (o1.Data > 360) Then
      o1.Data = o1.Data - 360
   End If
   PROC_Compass = o1
End Function
```

Example 5. Custom Measurement

Basic allows custom measurements to be created that can be added and scheduled by the user to run on a periodic interval. They are implemented as public subroutines that begin with "MEAS_". They are added and scheduled just like standard measurements using the Station Setup/Measurements menu. Custom measurements do not currently accept inputs or provide outputs, but this does not mean they can't perform I/O. For example, this measurement can be used to take an A/D reading and log it:

```
REM Sample1.bas – take an A/D reading and log it.
Public Sub MEAS_Sample1
   A=Ad(1,1)
   Result = 1.2*A^2 - 0.5*A + 2
   Open "Data.log" For Log As #1
   Log #1, Now, "Analog1", Result, "G", "Volts"
   Close #1
End Sub
```

Development Cycle

You create BASIC programs on a PC using your favorite editor and then upload them to the 8310. The BASIC programs are checked when you toggle recording or using Diagnostics/Basic Status and error messages are generated to inform you of problems in the code. These messages can be viewed in System Status or in the system log.

Chapter 11: Maintenance and Service

This chapter gives information needed to maintain and service an 8310. Its topics include general site maintenance instructions, 8310 assembly and disassembly, jumpers, initializations and resets.

This maintenance section describes the inspections and tests that should be performed on a working station to insure its continued reliable operation. If all the proper guidelines were followed when installing the site, maintenance should be quick and needed once a year. Included are checks of the enclosure, sensors, cabling, battery, antenna and 8310 itself.

Enclosure

Visually check the environmental enclosure and look for signs of moisture entering in. In some cases the enclosures "sweat" which does not cause great problems with the 8310 since it has a protective box surrounding the boards and the boards themselves are conformally coated. If a leak is discovered in the enclosure, it should be sealed. At locations where there is very high humidity, desiccant bags may be put inside the enclosure to absorb excess moisture. Desiccant bags do loose their ability to absorb water over time so they should be replaced at each maintenance visit.

Sensors

Check the accuracy of the value the 8310 has measured for each sensor. If possible, take with you a calibrated instrument for making an independent reading. Note that measurements such as temperature vary significantly depending on where the sensor is placed.

Check all the sensors for signs of wear and tear. If shaft encoders are used, make sure the shaft spins freely with no signs of binding or wobbling. For wind speed/ direction sensors, make sure it is able to rotate 360 degrees and the prop spins freely without binding. Tipping buckets should be checked for anything which may clog up the funneling mechanism and obstruct water flow into the buckets. Manually tip the mechanism 10 or so times and verify the 8310 counts the correct number of tips. If not, the mercury switch may need adjustment.

Cabling

Inspect the ends of the cables coming from the sensors. If they were tinned properly, they should not need servicing. If they were not tinned, they may be starting to fray in which case the ends should be cut, restripped, and properly tinned. It is very important to maintain good, clean connections between the 8310 and the sensors being used.

Battery

If external batteries are being used, there may be an in-line fuse between the battery and the 8310. Many users have mentioned that oxidation on the fuse holder itself is a cause of many intermittent failures. Just as dirty battery terminals in your car will cause it to not start, the same holds true when the 8310 tries to transmit. Therefore the terminals on the battery should be cleaned in addition to the terminals in the fuse holder.

In conjunction with dirty terminals causing battery related problems is the problem experienced with most batteries and their inherent designs. The types of batteries that are commonly used

at DCP sites are Marine deep cycle or the standard type used in most cars. When the manufacturers of these batteries designed them, they relied on the assumption that they would always be located in a car, boat, or other moving object which would be constantly vibrating somehow. This constant vibration keeps particles in the electrolyte suspended not allowing them to fall to the bottom and bridge between the plates thus shorting the battery internally. Therefore, each time the site is visited, it is good practice to pick up and shake the battery for a couple of minutes thus extending the life of it considerably.

To test the battery to make sure it is good, you must measure the battery voltage while under a load. If you have an 8310 with a GOES transmitter, you can measure the voltage during a transmission. For other systems, you will want to at a minimum turn on the 8310 displays and set the brightness to full. If the battery is charged, the voltage should not drop any more than 0.5 volts when current is being drawn by the system. If the drop is more than this, the battery is not fully charged and may be defective.

Antenna and Cable

Check the antenna cable making sure the ends are securely fastened. Since the ends are handled most frequently, they are the main source of problems with the cable. Make sure there is sufficient weather proof tape coating the ends not allowing water to find it's way to the connections.

Inspect the positioning of the GOES antenna and reposition if necessary. Sometimes high winds or large birds roosting can cause them to be moved thus lowering the signal level going to the satellite. Make sure there is no corrosion or other foreign material on the outside of the antenna since any material on it could cause reflected power and further signal loss.

8310 Errors and Status

A very useful feature of the 8310 is that it displays errors at the top of the main menu. Refer to the section Errors for more details. In addition, the many features of the diagnostics menu provide a means to assess how well the system is operating and if there are any issues that need to be resolved. Refer to the diagnostics section of the manual for more details.

Disassembly/Reassembly 8310-N

The 8310 package requires no disassembly to examine internal components. To access the inside of the 8310, simply loosen the thumb screws on the right of the front panel. The front panel will then swing clear, providing access to internal boards and cables.

CAUTION: Use ESD precautions when the unit is opened up.

Disassembly/Reassembly 8310-O

The following steps can be followed to disassemble an 8310-O.

1. Remove all cabling and grounding from the 8310-O.

2. Use Philips head screwdriver to remove the four screws at the corners of the end panel and remove end panel.

3. If more than just end panel access is needed, repeat the above step to remove the other end panel and then remove the six screws for the bottom plate.

CAUTION: Use ESD precautions when the unit is opened up.

Standard port assignments

When configuring the 8310 for communications follow these guidelines:

Use COM2 Satlink
Use COM3 Voice

Jumpers and Connectors 8310

CPU Module Jumpers

Note: 7310 does not support power on COM1 pin9, and does not have COM2 or COM3.

Jumper	Position	Description
J6	**See figure below**	**Com1 pin 9 configuration – Default is RI**
J14	**See figure below**	**Com2 pin 9 configuration – Default is RI**
J23	**See figure below**	**Com3 pin 9 configuration – Default is RI**

Default Jumper position

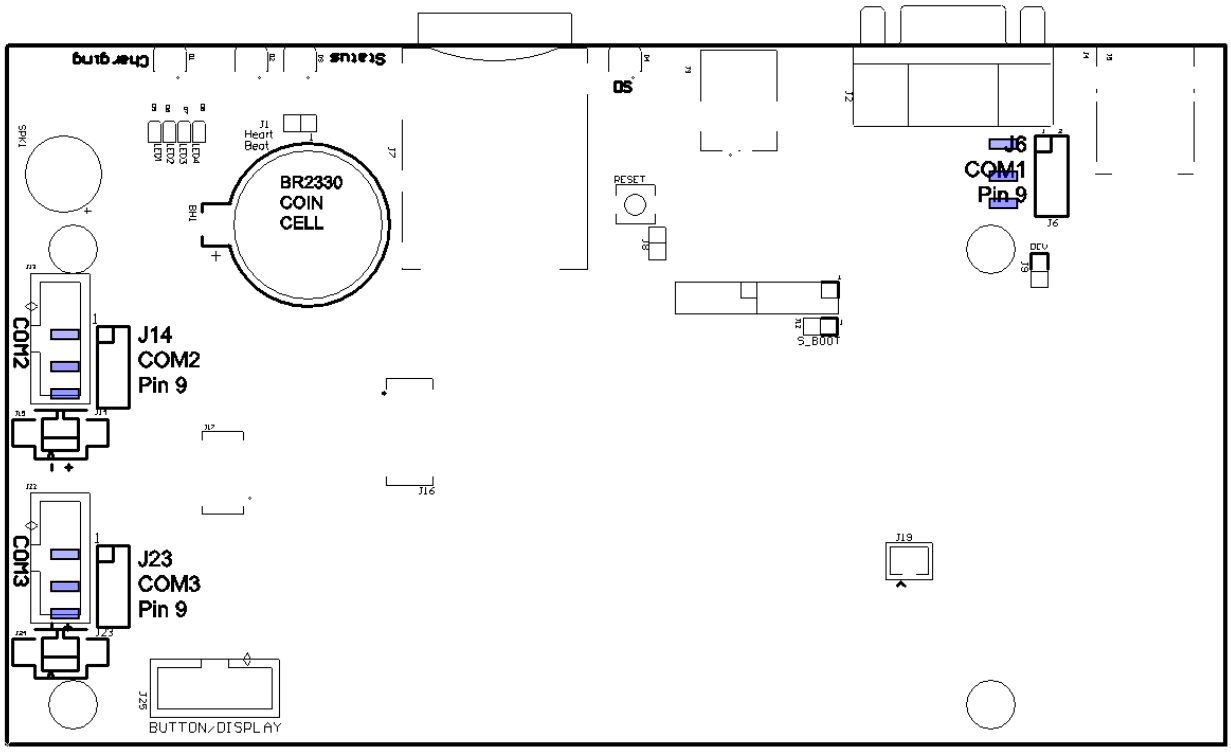


Figure 12 - Location of COM1-3 Configuration Jumpers

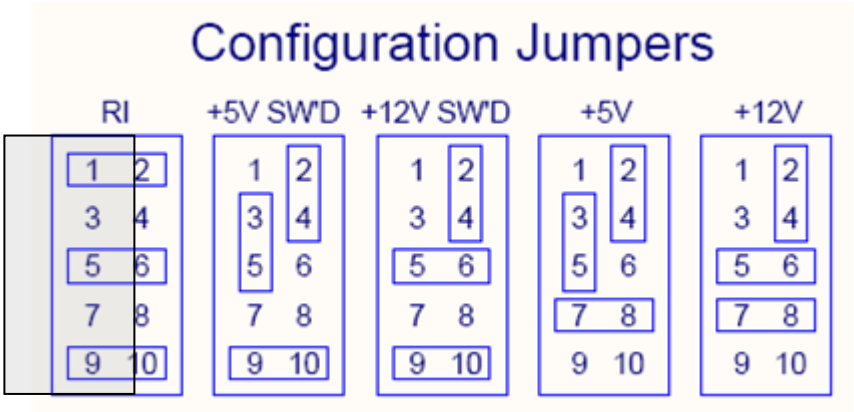


Figure 13- Comport Configuration Jumper Settings

8310-N Protection/Termination Module Jumpers

Jumper	Position	Description
J7	Even pins in above figure against PCB	COM4 Pin 9 configuration - Default is RI
J9 – AN1	V position (see figure below)	V position for measuring voltages on AN1 or 4-20mA with 100 ohms switched in only during measurement. I position connects precision 100 ohm resistor from input to ground at all times.

Jumper	Position	Description
J9 – AN2	V position (see figure below)	V position for measuring voltages on AN1 or 4-20mA with 100 ohms switched in only during measurement. I position connects precision 100 ohm resistor from input to ground at all times.

Default Jumper position

Termination Board J9 location/orientation showing voltage input as default configuration

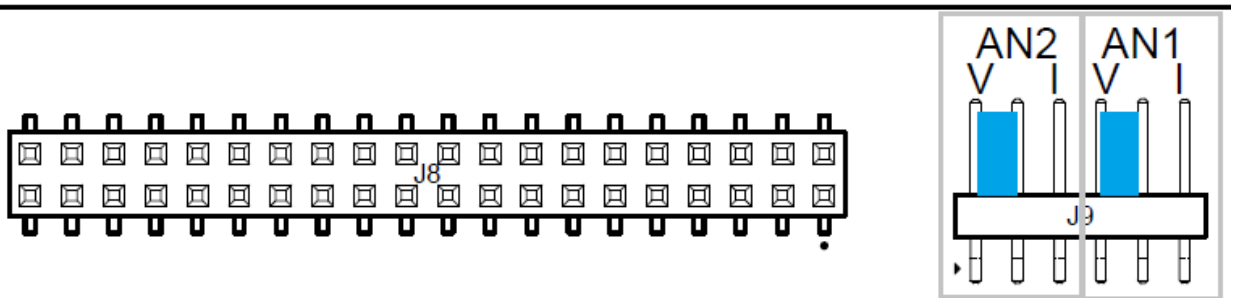
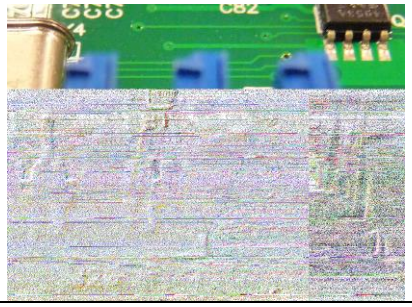


Figure 14 - J9 - AN1 and AN2 input mode jumpers

8310-O Protection/Termination Module Jumpers

Jumper	Position	Description
J20	Bottom board The end next to the crystal is where Pin 1 & 2 are located as shown in the picture. Refer to Figure 13 for settings.	COM4 Pin 9 configuration - Default is RI 
JJ11 – AN1	V position (see figure below)	V position for measuring voltages on AN1 or 4-20mA with 100 ohms switched in only during measurement. I position connects precision 100 ohm resistor from input to ground at all times.
J12 – AN2	V position (see figure below)	V position for measuring voltages on AN1 or 4-20mA with 100 ohms switched in only during measurement. I position connects precision 100 ohm resistor from input to ground at all times.

Default Jumper position

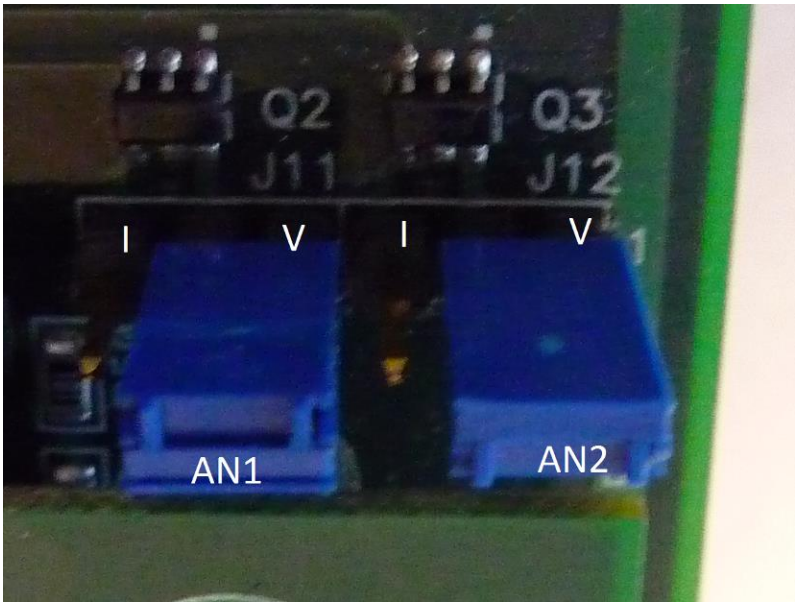


Figure 15 - J11 and J12 - AN1 and AN2 input mode jumpers 8310-O

Satellite Module Failsafe Reset

NOAA-NESDIS requires that all GOES transmitters be equipped with fail-safe circuitry. The fail-safe circuitry is designed to prevent transmitters from jamming a channel. The fail-safe limits both the length of transmissions and the time between consecutive transmissions.

Use the *Diagnostics/SATLINK Test/Satlink Status* menu to view the status which will include a message if the failsafe is tripped. The *Reset Failsafe* function in the same menu will reset the failsafe. You can also reset the failsafe by pressing the small button located on the end panel of Satlink.

Telephone Module Jumpers

Sutron's voice modem has the following jumpers. The modem is expecting to be powered by Pin 9 of the serial cable. Set the comport jumper to provide 12VDC on this pin to power the modem. See Figure 12Figure 12 - Location of COM1-3 Configuration Jumpers and Figure 13-Comport Configuration Jumper Settings above for details.

JUMPER	JUMPER POSITION	Function	FACTORY DEFAULTS	8310
J5 DSR	1-2	DSR=CD		
	2-3	DSR=DSR (normal)	**X**	X
J4 Wake-up	1-2	Wake on RTS		
	2-3	Wake on DTR	**X**	X

J3 Pin 9 use	1-2	RI out		
	2-3	Power in	**X**	X

Chapter 12: Troubleshooting

This chapter gives instructions on how to troubleshoot an 8310. You will want to review this chapter to learn better how the 8310 operates as well as service a site that may have a problem.

Introduction

The 8310 was designed for rugged field operation in extreme conditions. We have done our best to provide you with a reliable data logger. In the event you have trouble with the 8310, we recommend that you first look for the cause in the most obvious of places. Many common problems come from simple sources. Corroded or damp connectors probably cause 95 percent of all problems, followed by old, failing batteries and improper setup.

General Troubleshooting Procedures

Troubleshooting should always follow a logical progression. The intent should always be to isolate the problem to a specific area, and then focus on that troubled area. Is it an instrument problem? Is it a power problem? Is the unit set up properly? The following paragraphs describe how to isolate problems.

Display will not light

The display should light when power is first applied to the 8310 or when any key is pressed. If the display does not light as explained, the first suspects should a dead main battery.

To check an external battery, simply measure the voltage on the battery using a Volt Meter. To check an internal battery, you must first open the unit in order to reach the battery.

If the battery voltage is less than 9.5v then the battery is either discharged or faulty and must be replaced or recharged. A normal battery will read 11 to 13 VDC without charging and 13 to 14.7 volts under a charge. Disconnect the charging voltage if it is present to get a good measure of the batteries condition.

If the 8310 will not power up after you have checked and/or replaced the battery, you may have a serious problem and the unit must be returned to the factory for repair.

8310 turns on but does not work properly

When the 8310 display will come on, but you still have problems then you must determine whether you have a hardware problem or a setup problem. Hardware problems occur when sensors quit, wires become loose or corroded, or things are wired incorrectly. Setup problems are those in which signals get to the 8310 but are not properly sampled, processed, or recorded.

Sensor problems

Hardware problems may show up in several ways. Two of the most common ways are; (1) inability to obtain sensor data at a new installation; and, (2) data for one or more sensors disappears at a site that has been working properly.

The first place to begin diagnosing a sensor hardware problem is the 8310 unit. Turn the 8310 display on and use the arrow keys to move to the Diagnostics/Inputs sub-menu. Use the up/down arrow keys to display each sensor and check to see if each is providing a reading. For sensors that require switched 12 volts, check that switched power setting is configured correctly.

After you have the live readings for the sensor on the display, logically work in an outward direction from the 8310 to the sensor. Here are some of the questions you should ask:

- Are the sensor wires properly connected to the terminal block? (Correct polarity? Screws tight?)
- Are the wires from the terminal block to the sensor OK?
- Is there a connector at the sensor end?
- If there is, is it solid? Is there moisture in it?
- If this is an analog sensor, can I measure a voltage output at the terminal block? At the sensor end?
- If this is a switch closure device can I see the switch closure at the terminal block end with the wires disconnected?
- If I simulate the input (for example, hook up a known voltage across an analog input, or hook a switch across a counter) does the live reading value change properly?
- Is the 8310 drawing excessive current. Use an ammeter inline with the +12VDC positive lead to measure the current. Excessive current may be caused by a faulty sensor or wiring.

In most cases, if you can simulate the input, you should. This will ensure that the 8310 is operating properly. If you cannot get live readings off a sensor after checking the terminal block connection, the wires, and any sensor-end connector, then you probably have a sensor failure.

If you can measure output at the instrument but have no live readings then you probably have a corroded or loose connector or broken wire. Improper wiring should also be considered (polarity reversed).

If you are certain that signal is reaching the 8310 but the live readings are zero, then you may have a setup problem. Read the next section on diagnosing setup problems.

Setup Problems

Setup problems may also show up in several ways. Some of the ways include:

- data is not recorded on any sensor;
- data is not recorded from one or two of several sensors;
- all recorded data is zero or some incorrect value for a sensor; recording cycles are skipped.

If no data is recorded, there are two likely setup problems. First, for data to be recorded (logged) you must have Log turned ON. Second, Recording must be ON in the main menu. If

Recording is OFF then no data will be recorded for any sensor. If Log is *none* for any sensor, that sensor will not be recorded

If recorded values for a sensor are all zero or some incorrect value, even when you know the input levels are correct, then there is probably some error in the processing. Use the inputs menu to first examine raw values and compare them to the converted values. If the wrong processing is selected and/or the processing coefficients are incorrect, the converted value will not be correct. If the converted value is correct, check the processing selected for the output.

If the 8310 appears to be skipping recording cycles then the problem is probably in the setup of the measurement time or *Interval*. When you set up a measurement, remember that the timing is ultimately limited by the time it takes to measure the specific sensor. Some sensors can be measured in a fraction of a second while others take seconds or even minutes to complete. If you have a schedule that does not provide adequate time for the measurement to complete, the system can skip measurements.

LOS Radio Communications Problems

LOS radio communications problems are difficult to solve because of the number of factors that can cause problems. This list includes:

- ☑ setup errors
- ☑ radio frequency off
- ☑ radio transmitter deviation too high/low
- ☑ radio/modem mismatch
- ☑ antenna/cable problems
- ☑ path problems
- ☑ interference problems.

The place to start to troubleshoot radios is the 8310 itself. The 8310 maintains communications statistics giving the number of messages received and transmitted and the number of failures. These statistics can be viewed from the Diagnostics/Communications/COMx RADIO/ Test menu:

A typical report will be:

Radio: RX 155/541, 15 bad TX: 155, 10 bad

The first number following RX (the 155 in the example) is the number of messages the 8310 received that were directed to its Station ID. If this number is 0, the 8310 has not received any messages with its ID. The second number (541) gives the total number of messages received. This count includes messages that were addressed to other stations. The third number gives the number of messages that were received, but had errors indicating a corruption of the message. The numbers following TX give the number of transmissions that succeeded number of attempts and the number bad.

When you have communications problems you should note these numbers and decide what they tell you about the problem. Sometimes the answer will be clear just by looking at these values.

However, more often than not you will need to clear the status and then conduct a test of each path to see if it is working.

Here are some general steps to follow when debugging a radio setup.

- If you can have a person at site 2 while another is at site 1, try some simple tests shown in steps 2 to 5. Otherwise skip to test 6.
- Key the transmitter at site 1 with the "Turn On radio" option and then verify that carrier is detected at site 2.
- Unkey the transmitter at site 1 with the "Turn off radio" option, and make sure carrier detect drops at site 2.
- Key the transmitter at site 2, verify that carrier is detected at site 1.
- Unkey the transmitter at site 2, and make sure carrier detect drops at site 1.
- Try sending a test mail message from site 1 to site 2 with the "Send Mail Message" option. Select a destination (the default of "*" will cause the message to be sent to every unit) and a message to send. Start with a short simple message, and then lengthen it to stress the radio. You will receive either the message "Mail Delivered." if an acknowledgment was received or "Operation Failed." if an acknowledgment was not received.
- Try the same test at site 2 if possible.
- If you cannot get steps 1 through 7 to function reliably then the rest of your radio system will not work.

You may also debug communications problems using the 8310's command prompt. The main advantage here is you can monitor communications with the built-in SSP decoder. Issuing the command "report ssp" from the 8310's command prompt will allow you to see SSP messages being received or sent on any of the 8310's communications ports. To watch a particular port you can specify the port number (ex: "report ssp2" would monitor SSP traffic on COM2:). To monitor SSP traffic over TCP/IP, issue the command "report ssp0". The decoder can help identify problems in the setup. When working from the command prompt, the "status" command is very handy for observing message counts, and the "mail" command can be used to send or check for test messages. In general, the master station sends an SSP opcode, and the receiving station responds with either a response opcode or an acknowledgement. Each message also has a "to" and "from" address. If the "to" address doesn't match the unit receiving the message, it will neither process nor acknowledge the message. For instance, when an 8310 sends an alarm message, it will send a message with the opcode OpAlarm, and expect back an OpAck of the OpAlarm. In a functioning system you will see both messages using the SSP decoder.

The PASSTHRU command may also be used to take over control of a serial port and send characters to the attached device. Depending on the device, this can be used to help verify proper wiring, power, and operation.

Troubleshooting Guide

The following table lists a variety of problems which may occur with an 8310 along with the likely cause/solution.

PROBLEM	PROBABLE CAUSE/CORRECTION
Display will not light	Battery discharged or worn out, check battery voltage. External charging circuit faulty. System may be resetting which can take several minutes - see System Resets.
Unit will not record data	Recording is OFF in main menu - turn Recording ON.
No recorded data for one sensor	Log is none for output Go to MxOx sub-menu and turn on Log for missing values.
All sensor data recorded as zero	SLOPE set to zero in a processing function MxI1 and/or MxOx - go to sub-menu and set slope to correct value. Use 1.0 if sensor reads out in user units. Possible hardware problem - go to Diagnostics/Inputs sub-menu and see if data are reaching 8310 - if not, perform hardware diagnosis on wiring and sensor.
Excessive power usage	Power usage is a function of how many sensors are connected, how long they are turned on, and how often they are sampled. Minimize power consumption by sampling as infrequently as possible, turning on the +12v power only when needed, and keep the Measurement Interval as long as possible. Disconnect the sensors to see if one of them is causing excessive power drain.
8310 looses clock time when main battery is changed	Make sure the on-board RAM battery is >2.6 volts.
Unable to transfer a setup from a SD Card	

PROBLEM	PROBABLE CAUSE/CORRECTION
Battery slowly discharges even with external charger	
Display is too dim	To change the display contrast, press OFF/CANCEL down and then press RIGHT (increase contrast) or LEFT (decrease contrast).
Averages are not computed	Select Measurements menu and observe status information of the sampling. Turn on diagnostics and examine logs for the cause.
Pressure transducer gives incorrect or no readings	Use diagnostics menus to examine the input, the connections and the raw values measured.
SDI-12 Sensors do not operate	SDI-12 device set to wrong address. Use commands to query address or set to new address. Incorrect wiring or wiring short. Check wiring.
8310 will not communicate with another Sutron device	Check the baud rate in the sub-menu. Check cable wiring.
System runs for a short time and then resets	Possible low battery voltage If problem persists, return unit to factory
Telephone-equipped unit will not answer phone	Bad connection to telephone line Ring signal not present on line Improper settings of jumpers/switches, see Chapter 11 for correct settings.
Cannot transfer data from telephone-equipped unit	Check baud rate setting

PROBLEM	PROBABLE CAUSE/CORRECTION
GOES unit transmits at incorrect time	Make sure that transmit time is entered properly
GOES unit will not transmit	Check forward power of the transmitter at the antenna. Check back at the 8310 itself if there is no or low power at the antenna. Make sure the antenna cable is OK. Check the battery connection. Make sure it is made to the external battery input and not the solar panel input. Check the battery voltage during a transmission. The voltage should not drop more than 0.5 volts during the transmission. Make sure the voltage is greater than 10.5 and less than 14.9 volts. The 8310 will not make a transmission if the voltage is outside these limits. Make sure fail-safe has not tripped - use System Status - display status to check or look at recording status. .

SDI-12 Interface Standard

SDI 12 is a standard for interfacing to smart serial sensors. SDI-12 allows you to connect up to 10 sensors with as many as many as 9 parameters each. The interface is implemented using three wires: Data, Ground, +12V.

Grounding

The ground conductor of the SDI-12 interface line should be large enough to keep the voltage drop between the data recorder and the sensor to less than 0.5 volts during the maximum sensor current drain. Failure to observe this specification will cause bad communications and/or bad data.

Connector type

The connector type is not part of the SDI-12 specification. On the 8310, there are two interconnected sets of SDI-12 connections. They are labeled SDI-12: GND, PWR, and DATA.

Communications

Communications rate is 1200 baud.

SETUP of SDI sensors

Each SDI-12 sensor has an address from 0 to 9. This address differentiates one sensor from another. As they are shipped, they are almost always set to address zero (0). If/when you are interfacing more than one sensor to the 8310, you must set each sensor to a unique address. This is normally done by setting dip switches on the sensor, or by issuing SDI-12commands from the front panel or terminal interface of the 8310. Failure to set unique addresses for each sensor will result in failure of the communications interface, i.e. no data logged. Consult the sensor manufacturer's data sheet for information on your particular sensor(s).

SDI-12 commands to configure a sensor can be issued as follows: Navigate to the Diagnostics/SDI Tools/Send SDI-12 command menu, and press SET/ENTER. Use the arrow keys to set the characters of the command you want to send, and press SET/ENTER when done. The reply from the sensor will be displayed.

Useful SDI commands

Resetting the address of sensors is normally done by sending the aAb! command, where *a* is the current address of the sensor you want to change, and *b* is the address to which you want to change. For example, *0A5!* changes the address of sensor 0 to address 5.

Other initialization steps may be required for your sensor, prior to deployment. These may include calibration, sample interval, etc. You may be required to use the sensor manufacturer's test set for such operations.

The identification command can be used to help identify which SDI-12 sensors are connected. The identification command has the form *aI!,* wher *a* is the address of the sensor. For example, *3I!* commands the sensor at address 3 to return its identification string. Identification strings typically include the SDI-12 version number supported., the manufacturer's name, the sensor model number, the sensor's firmware version number, and sensor's serial number. This command is ideal for determining whether the correct sensor is at a given address, and whether

that sensor is responding properly.

To verify a sensor is able to measure data properly, you can issue the *aM!* command to tell the sensor to measure, and then the *aDx!* command, to view the measured data. For example, *7M!* tells the sensor at address 7 to measure. The sensor responds with a 5-digit code, where the first digit is the address, the next 3 digits are the time required for measurement to complete in seconds, and the last digit is the number of data values measured. After issuing the measure command, wait the number of seconds indicated. Then issue the *aD0!* command. The sensor will respond with one or more data values (to see all the measured data values, you may need to issue further *aD1!* --- *aDn!* commands, till you get all of the data. This is the same sequence the 8310 automates for you during scheduled measurements.

Power Consumption

On the 8310, the SDI-12, +12V line is protected by a thermal fuse. If you short this line, the thermal fuse will interrupt the power to the line. Power will be restored when the short is removed. The entire system load when the SDI-12 sensors are not communicating should be only a few milliamps per sensor. This will depend on the manufacturer of the sensors being used. You can measure the current flow through the +12 to check out the correct system operation. If the current draw is too high you will drain the system battery. Current draw under sample conditions will be much higher.

The maximum current used on the +12V line should not exceed 0.5 amps at any time.

Upgrading the Firmware

From time to time, Sutron makes available new versions of firmware, in order to introduce new features and fix bugs. These upgrades are typically made available as downloads on the sutron website (www.sutron.com/downloads/software.htm).

If your system is performing to your expectations, you may not want to upgrade, since there is always some risk of introducing a new problem into the system. If you are unsure whether to upgrade, and would like to know more about the contents of a particular upgrade (what it adds and what it fixes), contact Sutron Customer Service and request the engineering bulletin for the upgrade.

There are a few methods to upgrade the firmware in the 8310:

Method	Components Upgraded	Upgrade Remotely?
SD Card	Applicaton and kernel	No
Terminal (menu driven)	Application and kernel	Yes
Terminal (command line)	Application, kernel, loader, and micro monitor	No

WHEN UPGRADING v1.1.x TO ANYTHING HIGHER, YOU MUST UPGRADE THE LOADER!!! SEE, "Upgrade the Boot Loader", BELOW. AFTER UPGRADING THE LOADER, UPGRADE THE APPLICATION AND KERNEL.

DO NOT DOWNGRADE TO v1.1.x FROM A VERSION HIGHER THAN v1.1.x WITHOUT OFFLOADING YOUR DATA FIRST! DOWNGRADING TO v1.1.x FROM A HIGHER VERSION WILL RESULT IN A LOSS OF DATA ON FLASH DISK!

SD CARDS ARE SUPPORTED. SDHC CARDS ARE NOT YET SUPPORTED.

SD Card

This method offers the benefit of speedy application and kernel upgrades, but cannot be used to upgrade the loader or micro monitor. Hence, this method should only be used when it is clear no upgrade of the loader or micro monitor is needed (when in doubt, check with Sutron Customer Service).

1. Download the upgrade from the Sutron website (www.sutron.com/downloads/software.htm). The upgrade comes in a zipped file, and typically has a name similar to "8310_v1.3.1.zip", with the last set of numbers indicating the version of software.

2. Unzip the upgrade into a directory named "8310", off the root of your SD card.
3. Insert the storage card into the 8310.
4. The 8310 will prompt to auto-download the latest data to the SD Card. Press Cancel at this prompt, and then press SET at the Upgrade Firmware menu.
5. The upgrade will begin and finish automatically, and may involve a reboot.

Terminal (Menu Driven)

This method offers the benefit of remote upgrade, but cannot be used to upgrade the loader or micro monitor. Hence, this method should only be used when it is clear no upgrade of the loader or micro monitor is needed (when in doubt, check with Sutron Customer Service).

1. Download the upgrade from the Sutron website (www.sutron.com/downloads/software.htm). The upgrade typically comes in a zipped file, and typically has a name similar to "8310_v1.1.4.zip".
2. Connect to the 8310 using Hyperterminal or other terminal program supporting ymodem.
3. Start the 8310 menu interface by typing "ui" at the command prompt.
4. Select "Terminal Operations" from the main menu.
5. Select "Upgrade Firmware". At the prompt, send the upgrade zip using ymodem.
6. The upgrade will begin and finish automatically, and may involve a reboot.

Terminal (Command Line)

This method allows you to upgrade the boot loader and/or micro monitor, but cannot be done remotely.

Upgrade the Boot Loader

1. Download the upgrade from the Sutron website (www.sutron.com/downloads/software.htm). The upgrade typically comes in a zipped file, and typically has a name similar to "8310_v1.1.4.zip". Unzip the onto your PC.
2. Connect to the 8310 using Hyperterminal (or other terminal program supporting ymodem).
3. Power up the 8310. Press ESC in response to the message "Press ESC now to Upgrade System".
4. To upgrade the loader, press "**L**" then "**U**" to indicate you want to upgrade the boot loader
5. Use the menus that follow to specify either a transfer via ymodem or ethernet, and follow the instructions to send the 8310.lod, downloaded in step 1.
6. After the upgrade is complete, reboot the 8310.

Upgrade the Micro Monitor

1. Download the upgrade from the Sutron website (www.sutron.com/downloads/software.htm). The upgrade typically comes in a zipped file, and typically has a name similar to "8310_v1.1.4.zip". Unzip the onto your PC.
2. Connect to the 8310 using Hyperterminal (or other terminal program supporting

ymodem).

3. Power up the 8310. Press ESC in response to the message "Press ESC now to Upgrade System".
4. To upgrade the loader, press "**M**" to indicate you want to upgrade the micro monitor
5. Use the menus that follow to specify either a transfer via ymodem or ethernet, and follow the instructions to send the 8310.mon, downloaded in step 1.
6. When the system prompts, "Ok?", press "**y**"
7. After the upgrade is complete, reboot the 8310.

Appendix A Specifications

Specifications

8310

Electrical	
Power Required	10-16 VDC (20VDC max) reverse voltage protected Satlink Units: 10.4 to 15 VDC
Power Consumption (8310-N or 8310-O)	<3mA standby <40mA active typical with display off
Mechanical	
Enclosure	NEMA-4 Fiberglass
Dimensions	14"x12"x7.5" (36cm x 31cm x 19cm)
Display	2x20 character backlit LCD
Keypad	6 buttons
SD card slot with activity LED	For download data and read/write setups
Red Warning LED	Indicates setup or operational error
Green Heartbeat LED	Indicates unit is operating properly
Sensor connections	External terminal removable strips
Environmental	
Temperature	-40°C to +60°C (LCD operates to -20°C)
Humidity	0-95% Non-condensing
Communications	
Interfaces	1 RS232 for user setup 2 RS232 for communications 1 RS232 for serial sensor or other use True UART with baud rates up to 115,200 Ethernet
Devices supported (up to 2 Total)	Satlink GPRS IRIDIUM SBD Sutron Telephone Speech/modem Spread/Spectrum and LOS Radios Custom devices via BASIC
Protocols	SSP (Sutron Standard Protocol) Y-MODEM MODBUS Master/Slave MODBUS TCP Custom protocols via BASIC
Features	Simple Front panel setup
	Separate schedules for each measurement
	Multiple level averaging
	Powerful BASIC processor

	Autodump data when SD card is inserted
	SD card can also read/write setups
	Command-line interface for operation without custom programs
	Internal real-time clock w/battery backup. ± 5 sec/month (typical), ±10 sec/month (max) Optional GPS clock
	Flash memory log able to handle more than 1,000,000 readings, with additional logging to SD available
Solar Regulator	Operates as a float charger for sealed 12V lead acid battery.
	Built in temperature compensation.
	Also accepts DC power supply as charging source (15VDC recommended).
	Built in over current and thermal protection.
	Rated for solar panels up to 20W. Higher wattage will not damage, but built in protections may limit power delivered to battery.
SDI-12	V1.3 compliant recorder
	Two sets of SDI-12 wiring points on terminal strip
	Automatically combines requests to the same device
Analog Inputs	
Number Available	8
Input Range	-0.1 to 5V with respect to ground, single ended or differential
Single Ended Range	0-5 V, 78 mV, (with respect to ground)
Differential Range	+2.5V, + 78 mV, (+ input with respect to – input)
CMRR	120 dB typ
Input Impedance	> 10 Gohm typ
Accuracy:	0.002% of 5V typ
(differential	0.003% of 78mV typ HiGain
Measurements)	0.03% of 19.5mV typ x128Gain
Temp Coefficient	5 ppm/C typ

Ratio Accuracy	Limited by A/D resolution
Noise floor	RMS noise typically < 1bit on 78mV scale and above
Excitation	2.5V (up to 50 mA)
Protection	Multistage input protection including spark gaps.
4-20 mA	Precision load available for 2 analog channels. Loop source voltage provided by switched battery voltage
Digital Inputs	
Number Available	4
Types	Intended for tipping bucket, frequency or discrete inputs (quadrature takes 2 inputs)
Maximum frequency	8KHz, minimum pulse width 100 microseconds
Input range	0-5V (100KOhm pull-up to +5V provided)
Accuracy	±0.07% @200 ms sample interval ±0.03% @500 ms sample interval ±0.01% @1000 ms sample interval
Max Quadrature Frequency	4KHz
Digital Outputs	
Number Available	2
Output type	Open collector with 100 ohm current limiting resistor, 100 mA, 15V max
Switched Voltages	
Number Available	2
Types	Switched battery, Switched +5
Input/Output Expansion	Future: Additional analog and digital inputs and outputs can be added via external I/O expansion modules.
Module Types	Analog, 10 channels, 16 bit
	Digital, 8 channels, input or output

7310

Electrical	
Power Required	10-16 VDC (20VDC max) reverse voltage protected Satlink Units: 10.4 to 15 VDC
Power Consumption (8310-N or 8310-O)	<3mA standby <40mA active typical with display off
Mechanical	
Enclosure	NEMA-4 Fiberglass
Dimensions	14"x12"x7.5" (36cm x 31cm x 19cm)
Display	2x20 character backlit LCD
Keypad	6 buttons
SD card slot with activity LED	For download data and read/write setups

Red Warning LED	Indicates setup or operational error
Green Heartbeat LED	Indicates unit is operating properly
Sensor connections	External terminal removable strips
Environmental	
Temperature	-40°C to +60°C (LCD operates to -20°C)
Humidity	0-95% Non-condensing
Communications	
Interfaces	1 RS232 for user setup 1 RS232 for communications, serial sensor or other use True UART with baud rates up to 115,200
Devices supported (Only 1)	Satlink GPRS IRIDIUM SBD Sutron Telephone Speech/modem Spread/Spectrum and LOS Radios Custom devices via BASIC
Protocols	SSP (Sutron Standard Protocol) Y-MODEM MODBUS Master/Slave MODBUS TCP Custom protocols via BASIC
Features	Simple Front panel setup
	Separate schedules for each measurement
	Multiple level averaging
	Powerful BASIC processor
	Autodump data when SD card is inserted
	SD card can also read/write setups
	Command-line interface for operation without custom programs
	Internal real-time clock w/battery backup. $\pm$ 5 sec/month (typical), $\pm$10 sec/month (max) Optional GPS clock
	Flash memory log able to handle more than 1,000,000 readings, with additional logging to SD available
Solar Regulator	Operates as a float charger for sealed 12V lead acid battery.
	Built in temperature compensation.
	Also accepts DC power supply as charging source (15VDC recommended).
	Built in over current and thermal protection.
	Rated for solar panels up to 20W. Higher wattage will not damage, but built in protections may limit power delivered to battery.
SDI-12	V1.3 compliant recorder
	Two sets of SDI-12 wiring points on terminal strip
	Automatically combines requests to the same device

Analog Inputs	
Number Available	8
Input Range	-0.1 to 5V with respect to ground, single ended or differential
Single Ended Range	0-5 V, 78 mV, (with respect to ground)
Differential Range	+2.5V, + 78 mV, (+ input with respect to – input)
CMRR	120 dB typ
Input Impedance	> 10 Gohm typ
Accuracy:	0.002% of 5V typ
(differential	0.003% of 78mV typ HiGain
Measurements)	0.03% of 19.5mV typ x128Gain
Temp Coefficient	5 ppm/C typ
Ratio Accuracy	Limited by A/D resolution
Noise floor	RMS noise typically < 1bit on 78mV scale and above
Excitation	2.5V (up to 50 mA)
Protection	Multistage input protection including spark gaps.
4-20 mA	Precision load available for 2 analog channels. Loop source voltage provided by switched battery voltage
Digital Inputs	
Number Available	4
Types	Intended for tipping bucket, frequency or discrete inputs (quadrature takes 2 inputs)
Maximum frequency	8KHz, minimum pulse width 100 microseconds
Input range	0-5V (100KOhm pull-up to +5V provided)
Accuracy	±0.07% @200 ms sample interval ±0.03% @500 ms sample interval ±0.01% @1000 ms sample interval
Max Quadrature Frequency	4KHz
Digital Outputs	
Number Available	2

Output type	Open collector with 100 ohm current limiting resistor, 100 mA, 15V max
Switched Voltages	
Number Available	2
Types	Switched battery, Switched +5

Ordering Information

Part Number	Description
8310-N	8310, NEMA enclosure
8310-O	8310, non-NEMA enclosure
8310-N-S	8310, NEMA with Satlink*
8310-N-S-G	8310, NEMA with Satlink* and GSM/GPRS Modem*
8310-N-S-I	8310, NEMA with Satlink* and Iridium SBD transceiver*
8310-N-S-P	8310, NEMA with Satlink* and Telephone modem (voice and data)

*Antenna and cable ordered separately

Appendix B
Command Line Interface

The following table describes the supported commands. The "Access Level" column specifies the user access levels that may issue the command. For example, if "Setup" is the only access level listed for a particular command, then only users having Setup access may issue the command.

Command	Description	Access Level
ABOUT	Shows information about the programs running in the 8310	Setup&Data
CAL sensor data	Performs a single point calibration adjusting the sensor's calibration offset such that data will become the sensor's future value. The sensor name is specified using the measurement number and input number (ie: "M1.I1"). Calibration data is stored in the registry apart from the setup and hence will be retained even if a new setup is loaded.	Setup
CD path	Change directory	Setup&Data
COPY src dest	Copy a file. A wildcard * character may be used as part of the src to match one or more files, but then dest should contain the name of a folder. If a path contains spaces it must be surrounded in double quotes. ex: copy "\usb card*.*" "\flash disk\"	Setup
DATE [mm-dd-yyyy]	Displays or sets the date	Setup (when changing date) Date (when viewing date)
DEFAULT	Exits and runs \Windows\Remote COM1:115200	Setup
DEL file	Delete file	Setup
DIR path	Display directory	Setup&Data

Command	Description	Access Level
GET [sensor-list] [/F logfile] [/S mm-dd-yyyy hh:mm:ss] [/E mm-dd-yyyy hh:mm:ss] [/CSV] [/YMODEM] [/G] [/ZIP] [/C] [/REVERSE] [/BAD] [/INVERT] [/OLDEST] [/NEWEST] [/TODAY] [/YESTERDAY] [/WEEK] [/MONTH] [/YEAR] [/HOUR]	Shows archived log data. Specifying a sensor-list will cause only those sensors to be displayed. /F specifies a logfile, SSP.LOG is used by default. /S specifies a start date and time for retrieval. If a start date is not specified then it will default to where the last GET left off. /E specifies an end date and time for retrieval. If an end date is not specified the end of the log is assumed. /CSV will use a comma-seperated format . /CSV will also show more decimal places (by default only 3 places are shown to help keep columns aligned). /YMODEM will cause the report to be transferred as <sitename>_YYYYMMDD.TXT, where <sitename> is the name of the station, and YYYYMMDD is the date of the first entry in the log. If the data is from a log other then SSP.log then the format of the created will be as follows: <sitename>_<logfile>_YYYYMMDD.TXT. /G is similar to /YMODEM but will use the Ymodem-g protocol /ZIP will cause the output to be compressed in to a .ZIP archive with a .ZIP extension. If there are more then 24 lines of output, the display will pause with a "– More – " prompt until space is pressed to continue, or ESC to abort /C will cause the output to be continuous (without pause) until the end is reached or ESC is pressed. /REVERSE will cause the output to be generated in reverse time order (newest to oldest). /BAD will cause only bad data, and system errors to be displayed. /INVERT will display all sensors that are not contained in the sensor-list. /OLDEST will start the dump with the oldest data in the log. /NEWEST will start the dump with the newest data in the log, especially useful when combined with /REVERSE. /TODAY will start the dump with today. /YESTERDAY will start the dump with yesterday. /WEEK will start the dump with the last Sunday. /MONTH will start the dump with the 1st of the current month. /YEAR will start the dump at Jan 1 of the current year. /HOUR will start the dump at the top of the current hour.	Setup&Data
HELP	Displays the list of commands.	Setup&Data

Command	Description	Access Level
INFO	Shows information on the status of the 8310	Setup&Data
IPCONFIG [/ALL]	Displays the ethernet configuration information that has been assigned by a connected router via the DHCP protocol including the IP address assigned to the 8310. The /ALL option includes more detailed information including the physical address (ie MAC ID) and DHCP lease times.	Setup
LANAUTO	Turns Ethernet Power on when connected	Setup
LANOFF	Turns OFF the Ethernet (Local Area Network) interface	Setup
LANON	Turns ON the Ethernet (Local Area Network) interface. DHCP is used to locate the gateway, retrieve the IP address and other internet settings. Use the IpConfig command to view the current settings. Also related: Release, Renew.	Setup
LIST	Displays formatted setup	Setup
LOGOUT	Logout (also quit or exit)	Setup&Data
MAIL [port to msg]	Reads or sends mail message	Setup
MD dir	Make a directory	Setup
MEASURE […]	Measure works exactly the same as the SHOW command except it causes a live-reading of the sensor and/or tag values to be taken before the results are displayed.	Setup
MEM	Display memory usage	Setup&Data

Command	Description	Access Level
PASSTHRU port:parity,bits,stop [/HW] [/ECHO] [/BREAK] [/CONTROL]	Opens the specified COM port (either unopened or under the control of remote). Any characters typed are sent to the port. Any characters received are displayed. Terminate with by pressing ESC three times in a row. The /HW option enables RTS/CTS h/w handshaking. The /ECHO option causes the characters you type to be echoed back which can be useful when communicating with half-duplex devices. The /BREAK option will send a 500ms break to the serial port after connecting. This may be used to wakeup sensors which require a break. The /CONTROL option (added in version 3.4) allows the DTR control line to be passed through. This used to be the default behaviour, but as of 3.4 dropping DTR or disconnecting will cause a logout to occur. As of version 3.4, the normal user inactivity timeout will be applied to passthru sessions; previously a passthru session would not timeout. Note: If using passthru to access a port already under control of Remote, then the existing port settings are always used. This includes hardware handshaking. If you try to communicate with a port with hardware handshaking enabled, and CTS is low preventing transmission, then the message [CTS LOW] is displayed.	Setup
RD dir	Remove a directory	Setup
REBOOT	Reboots the 8310	Setup
RECORDING [on|off]	The RECORDING command will display the current recording status. If "on" is specified then recording is turned on, likewise "off" will turn recording off.	Setup (when turning on/off) Data (when viewing state)
RELEASE [adapter]	Releases DHCP leases on network adapters or the specific adapter if specified. The adapter index can be retrieved and the current lease viewed with the "IPCONFIG /ALL" command. DHCP leases are usually managed automatically, but this command can be used to verify that a connected router is assigning IP addresses reliably.	Setup
REN old new	Rename a file	Setup
RENEW [adapter]	Renews DHCP leases on network adapters or the specific adapter if specified. The adapter index can be retrieved and the current lease viewed with the "IPCONFIG /ALL" command. DHCP leases are usually managed automatically, but this command can be used to verify that a connected router is assigning IP addresses reliably..	Setup

Command	Description	Access Level
REPORT mode	Set status reporting to on, off, none, ssp[0-9], low, medium, high, i2c, all, debug. (more below)	Setup&Data
SET tag[:value] data	Sets the current value of a tag or setup property to the specified data. For tags with multiple possible values, the value number may be specified (1-n). If the tag contains spaces it may be contained in double quotes. Data may be an integer, a floating point number, or a double-quoted string. Setup properties that contain strings, intervals, or times should always be specified with double quotes.	Setup

Command	Description	Access Level
SHOW [sensor-list] [/SENSOR|/TAG/SETUP] [/CSV] [/YMODEM] [/G] [/C]	The SHOW command by itself will display the current value for every sensor and tag in the system in a tabular report. Sensors are the input blocks in the system and can be specified by measurement number and input number (ie: M1.I1), I/O connection (ie: AIO1:1) or both (ie: "M1.I1: AIO1:1"). Tags include any intermediate or final value in the setup marked with a ComsTag, a custom tag created with Basic, or a Field Variable. Specifying a sensor-list will cause only those sensors and tags to be displayed (sensors and tags can have the same name). Since the sensor-list uses spaces to separate items in the list, you may use double quotes to specify a name which contains a space (ie: "Wind Speed"). Specifying a setup property will display the current setting for that property. Specifying a section (for instance M1) will display all the properties under that section. You may also specify part of a property name and all properties that begin with that part will be displayed. /SENSOR shows only sensors. /TAG shows only tags. /SETUP will show only setup properties /CSV will use a comma-separated and quoted format that can be imported in to a spreadsheet. /CSV will also show more decimal places (by default only 3 places are shown to help keep columns aligned). /YMODEM will cause the report to be transferred using the Ymodem protocol as <sitename>_show.TXT, where <sitename> is the name of the station. /G is similar to /YMODEM but will use the Ymodem-g protocol If there are more then 24 lines of output, the display will pause with a "– More – " prompt until enter is pressed to continue, or ESC to abort. The [/C] option will cause the output to be continuous (without pause) until the end is reached or ESC is pressed. The alarm status of each tag is displayed. More then one alarm condition may be displayed. The following codes are common: OK – not in alarm H - high limit exceeded H+ - high limit entered h- - left high limit L - low limit exceeded L+ - low limit entered l- - left low limit R - rate of change exceeded R+ - rate of change entered r- - left rate of change	Setup&Data

Command	Description	Access Level
SHUTDOWN	Causes the 8310 app to exit so that it can be updated.	Setup
SMS cmd	Issue an SMS command (SMS HELP will display list) This command is only used for GPRS modem command processing	Setup
STARTUP	Runs 8310.exe from the \Flash Disk folder if it's there, otherwise from the \Windows folder. Updates the AUTOEXEC.BAT if the location has moved.	Setup
STATION [name]	The STATION command will displays station's name. If a name is passed to the command, then the station name will be set and the change will take effect immediately.	Setup (when changing name) Data (when viewing name)
STATUS [clear]	Display and or clear com port status	Setup&Data
STOP name	Stops a process forcibly	Setup
TASKS	Displays tasks and heap usage	Setup
TIME [hh:mm:ss]	Displays or sets the time	Setup (when setting time) Data (when viewing time)
TYPE [/C]	Display a to the screen. If the is longer then 24 lines the display will pause with a "– More – " prompt until enter is pressed to continue, or anything else to abort. The [/C] option will cause the output to be continuous (without pause) until the end is reached or ESC is pressed.	Setup
UI [/ANSI] [/VT100] [/SMALL] [/LARGE] [/2] [/SIMPLE] [/DUMB]	Displays the 25x40 user interface using ANSI graphics. The graphics mode will be negotiated with the terminal program to be either ANSI or VT100. [/ANSI] use ANSI graphics [/VT100] use VT100 graphics [/SMALL] a more compact 10x40 display [/LARGE] a larger 25x30 display [/2] mimics the 2x20 LCD display [/SIMPLE] 2x20 with simple graphics for better compatibility [/DUMB] 2x20 with no graphics (scrolling text) Note: on the keyboard ENTER=SET, ESC=OFF/Cancel, F1=Exit	Setup&Data
UPGRADE	Upgrade the software in the 8310 using Ymodem	Setup
VER	Displays the build date Remote was created	Setup&Data

Command	Description	Access Level
YMODEM [file-list] [/ZIP] [/F] [/G]	With no options specified, the YMODEM command will receive files using the Ymodem protocol and store them on the 8310. If the file being transferred has a .ZIP extension, then it will be automatically expanded and the contents stored in the current folder (typically \Flash Disk). The command may be used to send files using the Ymodem protocol by supplying a name or a file-list. A file-list is simply a list of files to send (delimited by spaces; use quotes around files containing spaces). /ZIP may be used when sending files to cause the files to be compressed in to a .ZIP archive before being transferred. The name of the archive will be the same as the first in the list with a .ZIP extension. A transfer can be aborted by pressing ESC 3 times. /G selects the Ymodem-g protocol, which can be much faster than standard Ymodem as it does not send an ACK character for each packet. Ymodem-g is not a reliable protocol as it cannot recover from a bad packet – it can only detect them, and it's been known to fail when sending large files (>90KB) from a PC using Hyperterminal because Hyperterminal gets too far ahead in the transfer and times out. /F selects a proprietary fast receive option which can speed up sending a file to the 8310 over a reliable link. It works by sending an ACK character before it has checked an incoming packet. The drawback to this, is that the protocol cannot recover from a bad packet; but because ACKs are still used it doesn't suffer from problems with large files like some implementations of Ymodem-g can.	Setup

Making Remote Setup Changes using Setup Properties

Setup Properties allow measurements, inputs, outputs, processing steps, and mux settings to be displayed or set using the command line (SET/GET/SHOW), SSP (GetTag/SetTag operations), or Basic (TAG() function). The properties may be identified by "setup point" or by output tag name.

Selecting a property by setup point is the most expansive and precise manner and follows the same syntax as the setup. M refers to a measurement, O to an output, I to an input, P to a processing step, and Mux to a mux setting. They are then strung together in the order they occur in the setup. For instance "M1.I2.P.Slope" and "MuxA.EnableChanel" are both is examples of setup points.

Selecting a property by tag is limited to selecting values that belong to the tag's output point, or associated measurement. For instance, "STAGE.NAME" would reference the output's name, "STAGE.P1.SLOPE" would refer to the slope of the first processing step used to compute stage, "STAGE.TIME" would refer to the measurement offset of Stage's measurement.

From the command line it's easy to explore the various points in the system using the SHOW command as it will show all matching properties. For instance "SHOW M1" will show all the properties for M1. If you want to see the input properties,

you would need to enter "SHOW M1.I1", "SHOW M1.I2", etc. You can show tag properties as well, but partial matching is not supported - you must specify the full name.

You can also set setup properties from the comamand line, but be sure to enclose strings in double quotes. For instance to change M1's measurement interval to one minute you would enter:

SET M1.INTERVAL "00:01:00"

Setup properties will sometimes infer what you intend. For instance, while the measurement interval does not belong to an output, if you specify it as such it will handle it (ie: M1.O1.Interval). In that case we were just typing more than we needed do as we could have just specified (M1.Interval). Where inferences come in real handy is with output tags, because for instance you can change the interval of a measurement that contains a tag named "STAGE" by specifying "STAGE.Interval".

Inferencing is especially import when working with Muxes, and makes making mass changes much easier. For instance entering the command 'SET MUXA.INTERVAL "00:01:00"' will change the measurement interval for every measurement that is associated with MuxA. Attempting to GET or SHOW MUXA.INTERVAL however, is not supported as it refers to multiple points.

Because numerous changes may be made at once, they are not instantly saved to disk. Rather they are saved after 5 seconds of inactivity, 30 total seconds, or during an orderly shutdown. Setup properties are stored in the setup file.

In some situations an attempt to set a setup property may fail (and much more rarely a get may fail as well). If you are positive you entered the correct syntax, you may wish to wait a bit and try again. The issue here is that setup properties may not be changed while the setup is being saved or when they are being actively used. The system will generally wait 2-6 seconds for access to a property to become available before giving up and reporting a failure. In some cases, recording may even be toggled in an attempt to make a change that cannot otherwise be made without doing so

Appendix C
Speech Phrases

Speech Phrases

0.vox ...zero...

1.vox ...one...

10.vox ...ten...

100.vox...one hundred...

11.vox ...eleven...

12.vox ...twelve...

13.vox ...thirteen...

14.vox ...fourteen...

15.vox ...fifteen...

16.vox ...sixteen...

17.vox ...seventeen...

18.vox ...eighteen...

19.vox ...nineteen...

2.vox ...two...

20.vox ...twenty...

200.vox...two hundred...

3.vox ...three...

30.vox ...thirty...

300.vox...three hundred...

4.vox ...four...

40.vox ...Forty...

400.vox...four hundred...

5.vox ...five...

50.vox ...fifty...

500.vox...five hundred...

6.vox ...six...

60.vox ...sixty...

600.vox...six hundred...

7.vox ...seven...

70.vox ...seventy...

700.vox...seven hundred...

8.vox ...eight...

80.vox ...eighty...

800.vox...800 hundred...

9.vox ...nine...

90.vox ...ninety...

900.vox...900 hundred...

a.vox ...a...

Account.vox ...account...

Ack.vox ...acknowledge...

Air.vox ...air...

airtemp.vox ...air temperature...

Alarm.vox ...alarm...

Alert.vox ...alert...

ammonia.vox ...ammonia...

Amps.vox ...amps

Analog.vox ...analog...

Any.vox...any...

At.vox ...at...

Auto.vox ...auto...

Average.vox ...average...

b.vox ...b...

Baro.vox ...barometric...

baropres.vox ...barometric pressure...

Bars.vox ...bars.

Battery.vox ...battery...

c.vox ...c...

Calibrate.vox ...calibrate...

Cancel.vox ...cancel...

carbon.vox ...carbon...

Celsius.vox ...Celsius.

Centi.vox ...centi?...

CFS.vox ...cfs(pronounced as "C", "F", "S")

Change.vox ...change...

chlorophyll.vox ...chlorophyll...

Close.vox ...close...

Closing.vox …closing.

cm.vox ...centimeters.

coastal.vox ...coastal...

Command.vox ...command...

concentration.vox ...concentration...

conductance.vox ...conductance...

Continue.vox ...continue...

Control.vox ...control...

Cooler.vox ...cooler...

Current.vox ...current...

d.vox ...d...

Daily.vox …daily…

Dam.vox ...dam...

Data.vox ...data...

Degrees.vox ...degrees.

DC.vox …degrees Celsius.

DF.vox …degrees Fahrenheit.

depth.vox ...depth...

Derivative.vox ...derivative...

Dir.vox ...direction...

Disable.vox ...disable...

DO.vox ...dissolved oxygen...

e.vox ...e...

Ed.vox ...?ed... (make words past tense)

Electronic.vox ...electronic...

Elevation.vox …elevation…

Enable.vox ...enable...

Encoder.vox …encoder…

Energy.vox ...energy

Enter.vox ...enter...

Error.vox ...error...

ErrorE.vox ...error.

f.vox ...f...

FAD.vox For archive data...

Fahren.vox ...fahrenheit.

Falling.vox ...falling.

False.vox ...false

Fan.vox ...fan...

Feedback.vox ...feedback...

Feet.vox ...feet.

FLD.vox For live data...

Float.vox ...float...

Flood.vox ...flood...

Flow.vox …flow…

For.vox ...for...

Freq.vox ...frequency...

g.vox ...g...

Gage.vox ...gauge...

Gallon.vox ...gallon

Gate.vox ...gate...

Gpm.vox ...gallons per minute.

GW.vox …groundwater…

Gust.vox …gust…

GD.vox …gust direction…

h.vox ...h...

Hand.vox ...hand...

HeadWL.vox …head water level…

Heater.vox ...heater...

Height.vox ...height...

Hertz.vox ...hertz.

High.vox ...high...

hLevel.vox ...harbor level...

Hour.vox ...hour...

HP.vox ...HP (pronounced as "H" ,"P")

HPA.vox …hectopascals.

Humidity.vox ...humidity...

Hydraulic.vox ...hydraulic...

i.vox ...i...

In.vox ...in...

INA.vox ...is not available.

Inches.vox ...inches.

Incorrect.vox ...incorrect.

Inflow.vox …Inflow…

Ing.vox ...?ing... (add "ing" suffix)

inorganic.vox ...inorganic...

Integral.vox ...integral...

Internal.vox ...internal..

Intruder.vox ...intruder...

Intrusion.vox ...intrusion...

Is.vox ...Is...

j.vox ...j...

Joules.vox ...joules (pronounced jewels)

k.vox ...k...

Kilometers.vox ...kilometers per hour.

Knots.vox ...knots.

KWH.vox ...kwh (pronounced as "K", "W", "H")

l.vox ...l...

Langley.vox ...Langleys.

Level.vox ...level...

Light.vox ...light...

Limit.vox ...limit...

Littleman.vox ...littleman...

Logic.vox ...logic...

Loop.vox ...loop...

Low.vox ...low...

Lower.vox ...lower...

m.vox ...m...

Malfunction.vox ...malfunction

Manual.vox ...manual...

Mercury.vox ...mercury...

Meters.vox ...meters per second.

Miles.vox ...miles per hour.

Mili.vox...mili?...

Mill.vox...million...

Milliamps.vox ...milliamps

Millibars .vox …millibars

Minus.vox ...minus...

mm.vox...millimeters.

monitor.vox ...monitor...

Motor.vox ...Motor...

n.vox ...n...

nitrate.vox ...nitrate...

nitrite.vox ...nitrite...

nitrogen.vox ...nitrogen...

No.vox ...No...

Normal.vox ...Normal.

Not.vox...Not...

Number.vox ...number...

o.vox ...o...

Oclock.vox ...o'clock.

Of.vox ...of...

Off.vox ...off...

OK.vox ...OK.

olevel.vox ...ocean level...

On.vox ...On.

Open.vox ...open...

Opening.vox ...opening...

organic.vox ...organic...

Orifice.vox ...orifice...

Out.vox...Out...

outflow.vox …Outflow…

Outliers.vox ...outliers...

p.vox ...p...

Password.vox ...password.

Pause.vox ...pause...

PCA.vox Please call again.

PEP.vox Please enter password

Per.vox ...per...

Percent.vox ...percent...

pH.vox ...pH... (pronounced as "P", "H")

PI.vox ...Pi (pronounced as "p" ,"i")

Please.vox Please...

Plus.vox ...plus...

Pneumatic.vox ...pneumatic...

Point.vox ...point...

Position.vox ...position...

Pound.vox ...pound.

PP.vox Please press...

PPP.vox Please press pound.

Precip.vox ...precipitation...

Press.vox ...press...

Pressure.vox ...pressure...

Problem.vox ...problem...

Proportional.vox ...proportional...

Psi.vox ...psi.(pronounced as separate letters "p", "s", "i" without pause between letters.)

Pump.vox ...pump...

q.vox ...q...

r.vox ...r...

Radar.vox ...radar...

Radial.vox ...Radial gate...

Radiation.vox ...radiation...

Radio.vox ...radio...

Rain.vox ...rainfall...

Raise.vox ...raise...

Rate.vox ...rate...

Recording.vox ...recording...

Relative.vox ...relative...

Reservoir.vox ...reservoir...

Rising.vox ...rising.

RL.vox …river level…

rlevel.vox ...reservoir level...

s.vox ...s...

salinity.vox ...salinity...

sample.vox ...sample...

sampling.vox ...sampling...

Satellite.vox ...satellite...

Satlink.vox …Satlink…

saturation.vox ...saturation...

Second.vox ...second

Sensor.vox ...sensor...

Sensors.vox ...sensors...

SIA.vox ...sensors in alarm...

Sil500.vox (1/2 second of silence)

Siren.vox …siren…

Slide.vox ...Slide...

Sluicegt.vox ...Sluice gate...

Snow.vox ...snow...

Soil.vox ...soil moisture...

Solar.vox ...solar...

Solenoid.vox ...solenoid...

specific.vox ...specific...

Speed.vox ...speed...

Ssss,vox ...?s... (make words plural)

Stage.vox ...stage...

Star.vox ...Star.

Station.vox ...station...

Std.vox ...standard deviation...

Steady.vox ...steady.

Stem.vox ...stem...

Stop.vox …stop…

Stopped.vox …stopped.

Sutron.vox ...Sutron...

Switch.vox ...switch...

t.vox ...t...

TAA.vox To acknowledge alarms...

TailWL.vox …Tail Water Level…

TDA.vox To disable alarms...

TEA.voxTo enable alarms...

telemetry.vox ...telemetry...

Telephone.vox ...telephone...

Temp.vox ...temperature...

Thanks.vox Thank you.

The.vox...the...

This.vox ...this...

Thous.vox ...thousand...

THU.vox To hang up...

tidal.vox ...tidal...

tide.vox ...tide...

Time.vox ...time...

TL.vox To list...

To.vox ...to...

Too.vox...too...

total.vox ...total...

True.vox ...true

TSI.vox The system is...

turbidity.vox ...turbidity...

u.vox ...u...

v.vox ...v...

Valve.vox ...valve...

Voltage.vox ...voltage...

Volts.vox ...volts.

w.vox ...w...

Warning.vox Warning.

Was.vox ...was...

Water.vox ...water...

Watts.vox ...watts

wdirection ...wind direction...

Wel.vox Welcome...

Welcome.vox Hello, Welcome to the Sutron Xpert.

Welcome7.vox Hello, Welcome to the Sutron 8310. (pronounce 8310, "Eighty" "Three" Ten")

WelcomeS.vox Hello, Welcome to the Sutron Satlink. (pronounce satlink, "Sat" "link" no pause)

WG.vox…wind gust…

Wind.vox ...wind...

WL.vox …Water Level…

WPM.vox ...watts per meter squared.

wspeed.vox ...wind speed...

x.vox ...x...

y.vox ...y...

z.vox ...z...

Appendix D
Telemetry Formats

This appendix contains descriptions for each of the telemetry formats supported by the 8310.

Handar Format

The Handar format is an ASCII, human readable format where sensors are separated by <CRLF>, sensor data is separated with a space, and missing data is reported as "M".

For example:

```
010034380517419:21:30G42+0NN155E9200070"
1.3 1.3 1.3 1.3
2.4 2.4 2.4 2.4
M 12.2 12.2 12.2 12.2 12.3 12.3 12.3
```

NFDRS and NIFC Formats

The NFDRS (National Fire Danger Rating System) and NIFC (National Interagency Fire Center) formats produce reports of human readable ASCII values using SHEF codes as labels for data.

The labels applied to measurement outputs are used to identify the data to include in the report. The following table shows what labels are recognized be the NIFC and NFDRS formatter. An "x" means the sensor label must appear in the setup for the formatter to succeed. The items with no "x" are recognized and will be formatted, but are not required.

Sensor	Label	NIFC	NFDRS
Rainfall	PCH	x	x
10-Min Avg Wind Spd	USH	x	x
10-Min Avg Wind Dir	UDH	x	x
Air Temperature	TAH	x	x
Fuel Temperature	MTH	x	
10-Min Avg Rel Hum.	XRH	x	x
Battery Voltage	VBH	x	x

Barometric Pressure	PAH		
Peak Wind Direction	UGX		
Peak Wind Speed	UPH		
Fuel Moisture	MMH		
Solar Radiation	RDH		x

Here's an example NIFC telemetry report:

```
00.00
000
270
328
110
100
14.0
000
000
020
0486
```

Here's an example NFDRS telemetry report:

```
00.00
000
270
328
110
100
14.0
000
000
020
0486
```

Note how there are no labels in the report. This is because the position of the data within the report determines the source of the data.

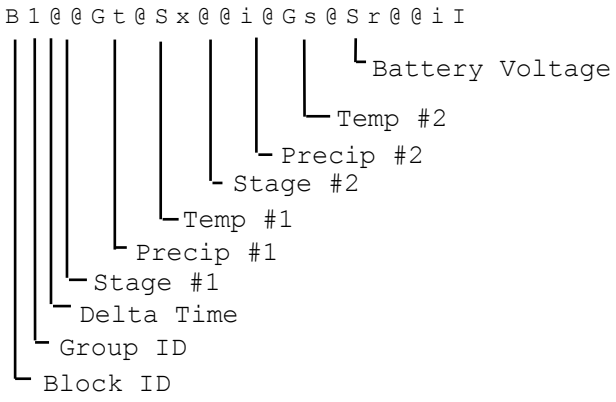
Pseudobinary Formats

Pseudobinary formats produce ASCII reports of 6-bit pseudo-binary formatted data values. The formats are "pseudo"-binary, because each sensor value is expressed in the range of ASCII characters, but not in such a way that is readily human-readable.

Pseudobinary B (Interleaved and Non-Interleaved)

The Pseudobinary-B Interleaved format is identical to the 8210 binary transmission format. "Interleaved" means the most recent values of all sensors come first, followed by the next most recent, and so on. "Non-interleaved" means all the data for sensor 1 is followed by all the data for sensor 2, and so on, i.e., the data is not "interleaved" according to time.

This pseudobinary format cannot be easily read by a person. Here's is an example message:



Pseudobinary-B Format

Name	Bytes	Description
Block ID	1	BLOCK-IDENTIFIER is always sent as "B" to indicate that this is the pseudobinary B format.
Group ID	1	GROUP-ID can be "1" to indicate a scheduled transmission, "2" meaning an alarm transmission, and "3" indicating a forced transmission.
Delta Time	1	Age in minutes of the most recent data
Data	3x num sensors	Data in either interleaved, or non-interleaved format. The example above shows the data interleaved (most recent of all sensors followed by next oldest, and so on). See the section below, "Six-Bit Binary Encoded Format" for details on how these values are encoded.
Battery Voltage	1	Logger battery voltage measured just prior to transmission

Pseudobinary-C Format

The Pseudobinary-C format also produces an ASCII report of 6-bit pseudo-binary formatted values, but with additional fields to describe label and time information. Just as the "B" version of the format, this format is "pseudo"-binary, because each sensor value and descriptor is expressed in the range of ASCII characters, but not in such a way that is readily human-readable.

Pseudobinary-C Format

Name	Bytes	Description
Block ID	1	BLOCK-IDENTIFIER is always sent as "C" to indicate that this is the pseudobinary C format.
Group ID	1	GROUP-ID can be "1" to indicate a scheduled transmission, "2" meaning an alarm transmission, and "3" indicating a forced transmission.
Measurement Delimiter	1	This byte is always a "+" and it is used to denote the start of measurement data.
Measurement Index (Sequence)	1	The Sequence number assigned by user in the output telemetry settings. This value is encoded 6 bit binary. Typically, the sequence number assigned is unique, allowing you to uniquely identify the data point.

Day	2	This 2 byte encoded 6 bit binary encoded number represents the Julian day of the year. The day tells when the most recent (first) sensor reading of this measurement was made.
Time	2	This 2 byte encoded 6 bit binary encoded number is a number of minutes into the day. It tells when the most recent (first) sensor reading of this measurement was made.
Interval	2	This 2 byte encoded 6 bit binary encoded number tells the measurement interval in minutes, or the amount of time between readings of this measurement.
Measurement Data	3 for each sensor reading	Sensor data encoded 6 bit binary.
Additional Measurements	Variable	If more than one measurement was setup for transmission, more data will follow. Each measurement setup will have data starting with the Measurement Delimiter and ending with Measurement Data.
Final Delimiter	1	This byte is always "." and it is used to denote the end of all measurement data.
Battery voltage	1	This is the battery voltage measured prior to making the transmission. The range of the number will be -32 to +31 and can be converted to volts by multiplying by 0.234 and adding 10.6 allowing a range of 3.1 to 18.1 volts.

Example message:

```
C3+ADGTU?///+BDGTU?@UI+CDGTU??~v///.L
Group              3 format C
Sequence           A     1
Julian Day         DG    263
Time               TU    21:41
Interval           ?     00:-1
Data:              ///   missing
Sequence           B     2
Julian Day         DG    263
Time               TU    21:41
Interval           ?     00:-1
Data:              @UI   1353
Sequence           C     3
Julian Day         DG    263
Time               TU    21:41
Interval           ?     00:-1
Data:              ?~v   -74
                   ///   missing
Batt V             L     13.4
```

Six-Bit Binary Encoded Format

The six bit binary format is used to encode numbers into displayable ASCII characters. Notice that fractional numbers cannot be represented, so for instance a battery voltage of 13.04 volts set up with 2 right digits will be sent as 1304.

- A 1 byte encoded number can range from -32 to +31.

- A 2 byte encoded number can range from -2048 to +2047
- A 3 byte encoded number can range from -131072 to +131071

Binary encoded numbers are always sent most significant bytes first. The number itself is broken down into 6-bit digits, and each digit is placed in one byte of data. The number 64 (ASCII "@") is added to each digit to make it fall within the range of displayable ASCII characters. The only exception is that 127 (ASCII <DEL>) is sent as 63 (ASCII "?")

Example 1. Encoding the number 10 in 1 byte:

Since 10 will fit in 6-bits we only have to add 64 which would yield 74. So the number 10 would appear as ASCII 74 or the letter "J".

Example 2. Encoding the number 12345 in 3 bytes:

First we have to convert 12345 into binary in 6-bit pieces:

12345 (base 10) = 11 000000 111001 (base 2)

Now we can convert each piece back to base 10:

11 000000 111001 (base 2) = 3, 0, 57

Finally, we add 64 to each piece and convert to ASCII:

67, 64, 121 = ASCII "C@y"

Example 3. Encoding the number -12345 in 3 bytes:

First we have to convert -12345 into two's complement 18-bit binary: -12345 (base 10) = 111100 111111 000111 (base 2)

Now we can convert each piece back to base 10: 111100 111111 000111 (base 2) = 60, 63, 7

Finally, we add 64 to each piece and convert to ASCII (since the second piece is 63 we leave it alone):

124, 63, 71 = ASCII "|?G"

Example 4. Decoding the 3 byte string "@SW":

This is just like encoding except we follow the steps backward.

First we convert all the characters to ASCII decimal codes:

ASCII "@SW" = 64, 83, 87

Now we subtract 64 from each piece and convert to 6-bit binary:

0, 19, 23 = 000000 010011 010111

Finally, we combine all the bits to form one 18-bit two's complement number and convert to base 10:

000000010011010111 = 1239

Pseudobinary-B/C over SMS Format

The Pseudobinary-B and -C formats contain 8 characters which cannot be sent over SMS using the standard GSM 7-bit character set without inserting additional characters. This is undesirable as it would reduce the number of bytes that can be sent over SMS from 160 to 80 (in the worst case). To work around this limitation, SMS messages that contain a Pseudobinary message will automatically be translated to replace non-supported characters with supported characters. Please note that this requires that the characters be translated back upon reception and before they can be passed to a decoder.

The following table describes the character translation that's performed:

ORIGINAL		REPLACEMENT	
HEX	CHAR	HEX	CHAR
5B	[	31	1
5C	\	32	2
5D	]	33	3
5E	^	34	4
60	`	35	5
7B	{	36	6
7C	|	37	7
7D	}	38	8
7E	~	39	9

SHEF and SHEFFIX Formats

"SHEF" format conforms to NESDIS Standard Decimal format specifications. The format is ASCII and readable by persons without the aid of a computer.

The standard decimal format is human readable while binary formats require some processing before the values can be read. The standard decimal format is generally twice as long as the binary transmission. This means that less data can be sent in the same amount of time using the standard decimal format.

An example of a standard decimal format message is shown below. This message comes from a station with three sensors in the self-timed group. The sensors have been named HG, PC and TA. The battery voltage is the voltage of the battery just prior to transmission.

```
:HG 0 #15 10.20 10.15 :PC 0 #15 50 49 :TA 0 #15 -22.
 | |  |  |     |      |           |                |
 | |  |  |     |    Precip      Temperature       Battery
 | |  |  |   Older gauge reading (by data interval time)
 | |  |  Newest gauge reading
 | |  Data Interval
 | Offset Time
Gauge Height
```

The names HG, PC, TA and VB used in the transmission are called SHEF Physical Element codes (PE codes) and are the names given to the outputs in the 8310. Be sure to change the output

names if you want specific codes sent in the transmission. NESDIS has a recommended list of SHEF PE codes on its website at http://noaasis.noaa.gov/DCS/htmfiles/schefcodes.html

"SHEF Fixed" is a special version of the SHEF format where numbers are fixed to seven decimal points.

SSP Format

"SSP" is a binary format following the specifications of the Sutron Standard Protocol, which is useful when transmitting to XConnect or Tempest master stations.

If you are interested in knowing more about the low-level details of the protocol, please contact Sutron Customer Service.

Text Format

The Text format is an ASCII, human readable format intended to convey the current status of the sensors, quality, and alarm state. It is similar in format to the "SHOW" command, and is intended for alarm messages. It's also the default format for SMS Alarm messages when SMSAlarmsEnable is set to "Yes". Sensor readings are separated by <CRLF>, while fields in the sensor data is separated with a space.

An example of a Text format message:

RTU01 12:22<cr><lf>

STAGE 4.55 G H+R+<cr><lf>

RAIN 2.0 G OK<cr><lf>

The message begins with the station's name ("RTU01") and the current time in HH:MM (12:22) format followed by a list of sensor readings containing the name of the sensor ("STAGE"), the value ("4.55"), the quality ("G"), and the alarm status ("H+R+").

In the above example "H+R+" indicates that STAGE is experiencing a high limit and high rate of change alarm, while the "OK" status for RAIN indicates that it is within expected limits.

Quality codes:

G: Good quality

B: Bad quality

U: Undefined quality

Alarm codes:

H: High limit exceeded

L: Low limit exceeded

R: High Rate of change

OK: Normal

A "+" after a code indicates that the sensor has just entered that state, while a "-" after a code indicates that the sensor has just exited that state.

GPRS and LAN Session Format

The GPRS and LAN devices send self-timed and alarm transmissions in a special format that permit the server to also issue commands. This is to allow communication to a device which has a non-routable IP address. This does not apply to SSP transmissions. The following is a description of the high-level session format used to encapsulate other formats such as SHEF or PseudoBinary:

Course of Events

1. Logger connects to Main or Backup Server
2. Logger sends Session Type Code<cr> (see below)
3. Logger sends StationName<cr>
4. Logger sends Report Type Code<cr> to indicate purpose of connection (see below)
5. Logger sends scheduled (or alarm) transmission data (if any)
6. Logger sends ETX (0x03) to mark end of data
7. Logger sends a 3 byte pseudobinary encoded CRC16 of previous data and a shared secret
8. Server sends user login command, !login=username,password<cr> and waits for logger reply (ETX)
9. If user login matches, logger enters command-line session (see operational details, below)
10. Server issues pending commands, and Logger processes and responds accordingly
11. When command processing complete, the Server disconnects

Session Type Code

"Session type" defines the processing that occurs on connection. Currently, there is only one session type, "0". This type is defined by the Course of Events above, and details that follow.

"0" = defined by Course of Events, above

Report Type Code

"Report Type code" describes the purpose of the transmission:
"0" = self-timed
"2" = entering alarm
"4" = exiting alarm
"6" = no data, command session only
"8" = forced tx (test tx initiated by user)

Command-line Session Details

The server may precede each command with a "!" to signal machine mode

When processing a command in machine mode, the logger:

Suppresses the command echo

Uses ETX (0x03) as the command prompt (i.e., follows the command response with ETX, rather than the normal command prompt)

Inhibits pagination (doesn't pause to wait for user input after outputting a full "page" of data)

Alternate Paths

Following send of ETX, logger disconnects the user specific timeout

60 seconds is permitted for login, logger disconnects on failed login

Appendix E
Iridium Header Format

This appendix describes the content of the ASCII header included in Iridium transmissions.

The Facts

Iridium modem buffers are limited in size, forcing software to limit the length of messages it can send at any one given time. If messages are allowed to exceed these buffer lengths, then multiple transmissions must be made to send a complete message. These messages include self-timed and alarm reports, command responses, file data, and log data. The 7/8310 has the requirement that it reply with command responses over Iridium as soon as the command is processed, which, given the way the 7/8310 does message checking, may occur between two halves of a self-timed transmission. In this scenario, the receiver will receive "interleaved" partial responses.

While packets of different types may "interleave" as described, the assumption is the packets of any given message will always arrive "in order" relative to each other (and, if not, the MOMSM number w/in the Iridium Gateway header can be used to determine order).

The Issues

The above raises the following questions:

- How does the receiver identify the scope of a packet (i.e., is the packet a complete message or only a partial)?
- How does the receiver differentiate between self-timed, alarm, and command response transmissions?
- How does the receiver know how to "stitch" together "interleaved" partial responses (e.g., partial self-timed followed by command response followed by remaining self-timed)?
- How do we transfer log and file data?

The Solution

The solution is to use a header and optional sub-header to identify the content of the message such that the receiver would be able to reassemble packets. Here are the characteristics of the header and sub-header:

- The header uses a single byte in the ASCII printable range to make it easy for humans to interpret the content
- The header byte identifies the packet type in terms of the content of the packet, e.g., self-timed, self-timed extended, entering alarm, entering alarm extended, etc. The "extended" types mean multiple packets are required to transmit the entire message.
- The extended packet types include a comma-delimited sub-header to describe the subset of data being sent. The first sub-header differs from all subsequent sub-headers, in that it includes the total size of the data being sent.
- A sub-header is also included when user indicates the station name should be included in the transmission

Packet Structure:

packet-type	sub-header	data

Sub-header 0, two options:

standard:

,id,start-byte,total-bytes:

with station name:

,id,start-byte,total-bytes,station-name:

Sub-header 1 thru N:

,id,start-byte:

where,

packet-type	:=	Numeric ASCII character defining packet type. See type definitions in table, below
id	:=	Numeric ASCII text defining the message id. Starts at 0. Rolls over after 99.
total-bytes	:=	Numeric ASCII text defining the total number of data bytes to be sent (data only, does not include overhead bytes)

start-byte	:=	Numeric ASCII text defining which byte of total-bytes is the start byte of the current packet. Starts at 0.
station-name	:=	Optional ASCII field that has station name. Formatted as ,N=STATION NAME

Packet Types

Hex Value	ASCII	Description
0x30	0	Self-timed
0x31	1	Self-timed extended
0x32	2	Entering alarm
0x33	3	Entering alarm extended
0x34	4	Exiting alarm
0x35	5	Exiting alarm extended
0x36	6	Command response
0x37	7	Command response extended
0x38	8	Forced transmission
0x39	9	Forced transmission extended
...		Reserved for future use
0x7D	}	User defined
0x7E	~	Look to next byte for meaning
0xFF		Binary data, reserved for future use

Customer Service Policy

Dear Customer:

Thank you for making the important decision to purchase Sutron equipment. All Sutron equipment is manufactured and tested to the highest quality standards as set by Sutron's Quality Assurance Department. Our Customer Service Representatives have years of experience with equipment, systems and services. We have electronic technicians with field and applications experience, not limited to technical school training.

Sutron Equipment Repairs

Sutron maintains a Repair Department at the Virginia factory (22400 Davis Drive, Sterling, VA 20164). Turn-around time normally ranges from 10-30 days after Sutron receives equipment for repair. Prior to returning any equipment for repair, please call Customer Service at (703) 406-2800 for a Return Material Authorization (RMA) number. Next send the faulty equipment back to the Virginia factory*.

Sutron Customer Service will repair Sutron-manufactured equipment sent to us for repair within 30 days of the time we receive the item or that repair is free of charge. Please provide our Customer Service Representative with your email address when receiving the RMA number so that we can email you when your equipment is received at Sutron and again when it is shipped back to you. Expedited repairs can be completed within one (1) week for an additional expedite fee of $200.00. Repaired equipment is warranted for a period of 180 days after the repair shipment date.**

Note: The 30 day guarantee does not apply to bulk shipments of 10 or more repair items. We appreciate your cooperation in achieving a quick turn-around by promptly providing cost approval decisions, Purchase Order and credit card information once we have supplied you with a repair estimate.

Customer Phone Support

Customer Service Representatives routinely handle a wide variety of questions every day. When equipment questions arise, please feel free to contact me or one of Sutron's Customer Service Representatives. We are available from 8:00 am to 8:00 pm EST Monday through Friday and will be happy to take your calls. The main Customer Service number is (703) 406-2800, extension #5. After 5 pm EST Monday through Friday, please use extension #6.

We typically answer most sensor and interface questions on the first call. If we cannot quickly answer a question on an interface, we will work with you until we find a solution.

Sometimes a problem is application related. Although we pride ourselves on handling 95% of application related questions over the phone, we maintain constant contact with our Integrated Systems Division and Engineering Division for additional assistance.

Training

Training is an important part of the Sutron Customer Service Success policy. With proper training, you will learn how to take advantage of all the benefits and tools that Sutron equipment provides. We are available for, and frequently provide, on-site introductory training at our Customers' facilities. We also hold three (3) day training seminars approximately four times per year at our Sutron headquarters in Sterling (near Washington, DC). Contact me or your Sutron Regional Sales Manager for details.

On-Site Visits

Of course not all problems can be fixed over the phone. Sometimes a customer needs an on-site technician to identify site related problems or troubleshoot a network. Sutron provides these services at a reasonable cost. Please call for details.

If you would like to learn more about Sutron products, please email sales@sutron.com.

Thank you again for your business,

Paul Delisi
Customer Service Manager
Sutron Corporation
pdelisi@sutron.com

**Transportation charges for equipment returns are the responsibility of the Customer.*

*** See Warranty on next page. Any products repaired or replaced under Warranty will be warranted for the balance of the Warranty period or for a period of 180 days from the repair shipment date, whichever is greater.*

Commercial Warranty

SUTRON MANUFACTURED EQUIPMENT

THE SUTRON CORPORATION WARRANTS that the equipment manufactured by its Manufacturing Division shall conform to applicable specifications and shall remain free from defects in workmanship and material for a period ending two years from the date of shipment from Sutron's plant.

Sutron's obligation under this Warranty shall be limited to repair at the factory (22400 Davis Drive, Sterling, VA 20164) or, at Sutron's option, replacement of the defective product. In no event shall Sutron be responsible for incidental or consequential damages, whether or not foreseeable or whether or not Sutron has knowledge of the possibility of such damages. This Warranty shall not apply to products that have been damaged through negligence, accident, misuse or acts of nature such as floods, fires, earthquakes, lightning strikes, etc.

Sutron's liability, whether in contract or in tort, arising out of warranties or representations, instructions or defects from any cause, shall be limited exclusively to repair or replacement parts under the aforesaid conditions.

Sutron requires the return of the defective electronic products or parts to the factory to establish claim under this Warranty. The customer shall pre-pay transportation charges to the factory. Sutron shall pay transportation charges for the return of the repaired equipment to the customer when the validity of the damage claim has been established. Otherwise, Sutron will pre-pay shipment and bill the amount to the customer. All shipments shall be accomplished by best-way surface freight.

Sutron shall in no event assume any responsibility for repairs or alterations made other than by Sutron. Any products repaired or replaced under this Warranty will be warranted for the balance of the Warranty period or for a period of 180 days from the repair shipment date, whichever is greater. Products repaired at cost will be warranted for 90 days from the date of shipment.

NON-SUTRON MANUFACTURED EQUIPMENT

The above Warranty applies only to products manufactured by Sutron. Equipment provided, but not manufactured by Sutron, is warranted and will be repaired to the extent of and according to the current terms and conditions of the respective equipment manufacturers.

EXTENDED WARRANTY AND ON-SITE MAINTENANCE

Extended warranty and on-site maintenance contracts are available. Price quotations may be obtained from Sutron Customer Service Representatives.