SATLINK 2
LOGGER & TRANSMITTER
MODEL SL2-G312-1

OPERATIONS &
MAINTENANCE MANUAL

Satlink G312-1

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Chapter 1: Introduction

PRODUCT DESCRIPTION

Satlink 2 is an improved version of Sutron's popular Satlink Logger. It is 100% backwards compatible and can do everything that Satlink Logger can. It is built on a modified hardware platform and features a lot of the same software. New features include the ability to make analog measurements on multiple channels. Satlink 2 comes in a slightly smaller package and has three LEDs on the front for status indication.

Satlink Logger is Sutron's multi-satellite data logger and transmitter that can be used to relay data through environmental satellites. For over 25 years, Sutron Corporation has been the leader in the design, manufacture, and support of satellite transmitters and data acquisition stations. Satlink Logger builds upon Sutron's vast experience of delivering over 25,000 field stations to customers around the world. Satlink Logger will be the reliable communications device of thousands of systems in the years to come.

Satlink Logger is designed to operate on the following satellites:

- GOES Domestic 100, 300, 1200 bps, timed and random reporting
- GOES International
- Meteosat, MSG (Meteosat Second Generation) 100 bps channels, timed and alert reporting
- GMS   100 bps domestic and international channels
- INSAT   4800 bps domestic channels
- FY2B   100 bps domestic channels
- ARGOS/SCD

Because of its advanced digital design, Satlink Logger has the flexibility to support the different satellites' special modulation and spectral requirements.

Satlink Logger is a stand-alone logger and transmitter. For many simple stations, Satlink Logger can make the measurements, log, format and transmit the data. The built-in SDI-12 interface gives Satlink Logger the ability to make measurements of a wide range of sensors including water level, water quality, wind, and temperature. Satlink 2 features multiple analog channels and allows the user to setup a variety of measurement configurations including differential and ratiometric. The built-in tipping bucket interface allows easy measuring of precipitation. Satlink Logger supports multiple independent measurement schedules. After making measurements, Satlink Logger can perform complex equation processing on the measured data. This allows the user to convert analog voltage readings into meaningful units such as temperature. Satlink can log the data into its secure flash memory. The log in Satlink Logger is capable of holding over 120,000 readings. If there is ever any problem retrieving the data through the satellite, the data can always be retrieved from the log memory through a fast serial download.

As a stand-alone logger/transmitter, Satlink Logger supports both scheduled transmissions and Sutron's popular adaptive random reporting transmissions. Scheduled transmissions can be configured for any satellite and the data can be formatted in SHEF or Pseudobinary formats. After each measurement is made, the data is tested and used to control random transmissions. Random transmissions can be configured to make frequent transmissions, when the data are changing rapidly or are in alarm conditions, and infrequent transmissions when the data are not in alarm.

Satlink Logger is typically set up by a PC or IPAQ Pocket PC running software provided by Sutron. This software makes it simple to configure Satlink Logger to collect, process, log, and transmit the desired data.

Satlink Logger can also be used connected to a Sutron 9210, 8210 or Xpert. These data recorders are capable of making their own measurements and formatting their own data for transmission. Satlink Logger offers Data Merge Mode in which Satlink Logger will combine data it collected from sensors with the data formatted by other recorders in a transmission. Sutron's Xpert and 8210 are "Satlink Logger aware" meaning you can set up Satlink Logger transmissions through the Xpert or 8210 without using Satlink Logger Communicator. This seamless integration makes a system that is easy to operate and use. (Note that you need to use Satlink Logger Communicator to set up Satlink Logger's measurement functions.)

FEATURES

Key Features

- User programmable from a pocket PC, desktop PC, or laptop PC via a simple visual screen (screens on page 2)
- Built-in logger - 120,000 readings from any sensor to Flash Memory
- 4 Analog Inputs for single-ended & differential input sensors
- Gain setting options on Analog inputs
- SDI-12 support facilitates adding a vast array of sensors
- Dedicated Tipping Bucket input
- Powerful mathematical equation editor for analog sensor data conversion with polynomial and trigonometric support
- Reference voltage output for direct thermistor support
- Switched +12Vdc output
- Unique front panel LED indicators for critical "health" information at a glance
- Forward and reflected RF power measured.
- Both scheduled & random (event driven) reporting & alarm detection
- Easy Data Merge allows Satlink to make & log its own measurements AND receive data from another logger
- Every unit includes Trimble GPS module with fast satellite acquisition
- Internal fl ash log can be downloaded @ 115200 Baud.
- Standard RS232 interface to data recorder
- Easy integration with Sutron 8210, 8080 Xpert, 9210 XLite, 8400 & 8200 Dataloggers
- Serial port for quick and easy firmware & field software upgrades
- Internal diagnostics to monitor transmission quality and GPS Performance

Specifications

Weight: 2.2 lbs.
Size: 5.55 in. x 7.70 in. x 1.75 in.
Environmental: -40°C to +60°C
Operating Voltage: 10.4 to 15 VDC, reverse voltage protected
LED Indicators
- Status
- Fault
- Transmit

Connections
- Power: Built-in cable
- GPS: SMA (Bulkhead Mounted)
- RS-232: DB9
- SDI-12: 3 position removable terminal strip
- Tipping Bucket: 2 position removable terminal strip
- Analog input: 8 position removable terminal strip
- RF: N-Type

Interface Protocol
- Sutron Satlink Logger protocol
- Supports other DCPs in dumb logger mode at 9600 baud

Measurements
- Supports 10 sensors or measurements
- Independent measurement schedules for each sensor
- Analog Inputs: 4 channels (single ended 0-5V, differential, or ratiometric)
- Tipping Bucket: Dedicated switch closure counter input
- SDI-12: V1.0, V1.1, V1.2, V1.3 sensors
- User enterable labels for sensors
- Powerful Mathematical Equation Editor for analog sensor data
- Equation processing allows user entry of virtually any equation
- Manually entered readings

Analog measurement specifications
- A/D Resolution: 24 bit A/D converter
- A/D Accuracy: +/- 0.02% FS @ 25°C, +/- 0.03% FS when Transmitting
- Temperature Coeff: +/- 5 ppm/C typ. +/- 10 ppm/C max
- Linearity: +/- 0.005% FS
- Reference Output: 2.5 Volt, 10 ma. max (for temperature sensors)
- Switched +12V Out: 500 ma. Max

Log
- 120,000 floating point readings
- Individual time stamps to 1 second
- Can log numbers as small as 1E-38 or as large as 3E+38 (IEEE32 float)
- Non-volatile flash memory
- Quality flag for each value

Data
- Data Merge Mode supports merging of Satlink Logger data with data from external logger prior to transmission
- Circular Buffer Mode - enhanced transmission data management. Excess data is stored & sent on subsequent transmissions.

Alarms
- User configurable for each sensor
- Alarm types: high alarms, low alarms, and rate of change alarms

Timekeeping
- Sync to GPS within 10 ms
- Frequency discipline to within 10Hz

Power Requirements @ 12.5 VDC
- Quiescent: 6 mA typ
- 300 BPS Transmission: 3.8 A (Typ)
- 1200 BPS Transmission: 4.8 A (Typ)
- Protection against open or short circuit loads on transmitter output

Recommended Antenna
- Sutron YAGI (10.5 dB gain), 5000-0080

Transmission Modes
- 100 BPS random and scheduled
- 300 BPS random and scheduled
- 1200 BPS scheduled
- 4800 BPS INSAT selectable 10 min. window (3 randomized repeat sequence)
- METEOSAT Alert & Self Timed
- ARGOS/SCD Format

Transmission Character Sets
- ASCII
- Pseudobinary

Transmitter Output Power
- Software selectable power levels

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- 7 Watt nominal, 100/300 BPS (+/- 1dB)
- 14 Watt nominal 1200 BPS (+/- 1 dB)
- 3.5 watt (adjustable to 18 watt) INSAT

Chapter 2: Getting Started

UNPACKING

Standard Items

Satlink Logger is shipped with the following:

- Diskette with Satlink Logger Communicator and SatComm Pocket PC programs
- GPS antenna with 5M cable
- Spare fuse (3AG, 8 AMP, slow blow)
- Terminations for the power cable
- Manual
- Superior customer service
- Superior performance, features, and value

Common Optional Items

- M-F DB9 cable
- M-M Null Modem Gender Changer (Sutron part number 3121-1700) (used with IPAQ Pocket PC)
- Sutron YAGI antenna
- Sutron 15-foot RG-8 antenna cable
- SMA-male cable to N-type female bulkhead cable for mounting in most enclosures
- Lightning arrestor for RF output cable
- Extension cable for GPS antenna
- Solar panel w/ regulator
- Battery
- Grounding cable kits

INITIAL CHECKOUT

The initial checkout is intended to confirm that Satlink Logger is operational.

Required Equipment

You will need the following equipment to operate a Satlink Logger. Some of these items are available from Sutron as optional ancillary equipment:

A 12-volt battery or power supply capable of supplying around 5 amps. A battery capacity of 24 amp hours is recommended as a minimum. Although smaller capacity batteries will function, the batteries may run low over extended periods in which the sun does not reach the solar panel. This may be experienced in applications in which snow accumulation is significant or when stations are installed in high latitude locations having shortened sunlight coverage.

An RF output cable to connect to an SMA - female output connector

A "dummy" 50 ohm load or a wattmeter with a 50 ohm load capable of 25 watts min

A PC with a serial port and a M-F Serial Cable (Sutron part 6411-1484) or

A Pocket PC (e.g. Compaq IPAQ) with a Serial Sync cable and a M-M Null modem adapter (Sutron part 3121-1700)

Proceed with these steps to install the software and check out Satlink:

1. Copy Satlink Logger Communicator to a PC. Connect the PC serial port to Satlink Logger's RS232 port.

    Or connect the PocketPC to your PC and run the setup program (e.g., SatCommPPCSetup2003.exe) provided by Sutron and follow the instructions. After SatComm is installed, connect the PocketPC to Satlink using the serial sync cable and M-M null modem adapter.

2. Connect the GPS antenna to the connection labeled GPS.

3. Connect the dummy load or wattmeter to the connection labeled "RF OUTPUT".

4. Connect Satlink Logger's power cable to a 12-volt battery or suitable power supply.
    - You will see the "STATUS" light flash several times during its startup sequence.
    - The LEDs will light up in sequence: first the green, then the yellow and finally the red.
    - After the startup is finished, all LEDs will turn off. The green LED will then flash every 5 seconds if Satlink is running, or every 10 seconds to indicate that it is stopped.

5. Run Satlink Logger Communicator program on the PC. Choose to work in "connected" mode. The program will notify you if it has communicated with Satlink.

6.
    Or run SatComm on the PocketPC.   If you see status information in the "System Status" box, the program has communicated with Satlink.

7. Your Satlink Logger is operating and ready to be configured.

8. Proceed to chapter 3.

Chapter 3: Understanding Satlink Logger Hardware

FRONT PANEL CONNECTIONS:

The following is a breakdown of the front panel connections and indicators.

RS-232 Connector

This connector is used to connect Satlink Logger to either another logger or to a PC running Satlink Logger's Visual Interface.

Front Terminal Strip

Satlink 2 features a removable terminal strip header. The headers allow for sensor wires to be screwed into the provided terminal blocks and easily disconnected from the Satlink 2 in the event of replacing sensors or changing the physical configuration.

There are five labeled contacts on the shared header. Two are used for the tipping bucket, and three for the SDI-12.

Tipping bucket

The tipping bucket is a contact switch. This means that each closing of the circuit counts as a "tip". There is no polarity on these contacts. However, one of the tipping bucket inputs is referenced to chassis ground as indicated on the endpanel label.

SDI-12

The SDI-12 interface is designed to work with a wide range of SDI-12 modules available from Sutron and other vendors. Check with Sutron for an updated list of the modules we offer. Sutron's SDI-12 interface is V1.3 compliant. This means that we support concurrent measurements, real-time measurements and CRC checks.

The SDI-12 interface is designed to connect to multiple SDI-12 devices. If you have more than one device, simply double up the wires in the connector. The +12V connection is protected with a self-resetting fuse so if you make a wiring mistake, simply correct it and the interface will reset itself.

If you have too many wires for the connectors, simply wire in an additional terminal strip. Sutron makes a convenient-to-use terminal strip for this purpose (part number 6461-1241).

GPS Antenna Connector

The provided GPS antenna cable should be connected directly to the SMA connector labeled "GPS ANTENNA". It is preferred that the cable length provided with the antenna be used with no extensions if at all possible. If, however, the cable must be lengthened, then use the cable recommended by

Sutron. The signals are of very high frequency and low quality extension cables will degrade the reception to the point of no reception. Also, DC voltage is present on the cable. Always be careful with the connectors and when running any tests that may short out the supply, such as "teeing" in a connection to connect a spectrum analyzer in the cable. Always provide a drip loop in the cable if the cable has an open path for water to be running down the cable.

The Satlink 2 provides 3.3 V DC power on the cable connector to power the remote GPS antenna. The system has a thermal overvoltage protection on the supply in the event that the cable is shorted to ground. Correction of the short will return the supply to normal operation.

NOTE: Never substitute an antenna of another manufacturer as this may cause operational problems. Contact Sutron Customer Service before making any substitutions.

RF Output Connector

Connect the transmission antenna cable between the N-Type female output connector labeled "RF OUTPUT" and the Sutron antenna. Always verify that the cable attached to this connector is tightened down firmly. Also, if the RF cable is run directly to the antenna and is loosely run through a hole in the building structure, always provide a drip loop in the cable to prevent water from draining into Satlink Logger's enclosure itself.

Status LED (Green)

If Satlink is running, it will flash every 5 seconds. The blinks are synchronized to the top of the minute. When measurements are made, the LED will flash twice.
Prior to a transmission (several seconds), this light will turn on.   At the end of transmission, the LED will turn off.
During bootup, the green LED comes on first, followed by the yellow, and finally the red LED to indicate general health. For more details, go to page 24.

Fault LED (Yellow)

If Satlink is malfunctioning, the yellow light will double blink every two seconds. For more information, please refer to the section "System Malfunction" on page .27.
If Satlink is stopped, it will flash every 10 seconds. A stopped Satlink will neither transmit nor measure.
A single blink every five seconds indicates that Satlink's GPS has not achieved not working optimally. It is normal for this indicator to come on for the first few minutes after bootup. However, if the blinking persists for more than a few minutes, check the GPS antenna and make sure it has a good view of the sky.
During bootup, the green LED comes on first, followed by the yellow and finally the red LED to indicate general health.

Tx LED (Red)

Tied directly to the RF circuitry, this LED comes on to indicate that Satlink is outputting power on the RF connector. If this light is on, Satlink is transmitting. The only exception to this is when at bootup, the three light sequence will quickly flash the red LED. In this sequence no RF power is transmitted to the RF connector. At all other times following bootup, this will indicate RF power present.

Failsafe Reset Button

This button is supplied to reset the failsafe. Any failure of Satlink Logger's microprocessor to turn off the transmission in a normal fashion will invoke the hardware failsafe feature. This is a permanently set latched relay that may only be reset manually. The reset may be done by pressing this button or by using the Satlink Communicator program. When a tripped failsafe is reset, there will NOT be an audible click as found in older products. It is not recommended to attempt resetting a failsafe during an actual transmission.

The reset button is configured as a one-shot configuration. Any attempt to permanently depress the reset button will not influence the tripping of the failsafe in the future. Do not mount Satlink Logger in a fashion that would depress the button inadvertently.

REAR PANEL CONNECTIONS:

The following is a breakdown of the rear panel connections.

Satlink 2 has the ability to measure voltages. There are a total of four analog channels located on the terminal header located on the rear panel. There is a terminal provided for each of the channels, a 2.5V reference voltage line, an analog ground, a switched 12V line (which the user can have enabled before and during analog measurements), and a switched 12V ground.

Analog Inputs 1- 4

Connect the single ended lines to inputs 1 through 4. The single ended inputs are referenced to analog ground (AGND).
Connect differential pairs to Analog Inputs 1 and 2 or 3 and 4. Both sides of the pair must be within 0-5V of analog ground.

2.5 V Reference

A 2.5 volt reference is provided for external use. It may only be used as a high impedance source.   It should not source more than 10 ma.   Do not attempt to use this reference to power a sensor. The 2.5 Vref should be referenced to AGND.

Analog Ground

If you are measuring a simple voltage (single ended, 0 to 5 Volts), connect the live wire of the sensor to be measured to any one of the analog channels and the ground wire to the AGND (analog ground) connector. For more details, please see the Analog Measurement section on page 53.

+12V Switched Power

A switched +12 volts is provided for sourcing a modest amount of current (< 500 ma max) to sensors that do not need to be powered up all the time. When the A/D readings are made, the switched +12 volts is turned on. The warmup period specified in the setup configuration will turn on the Switched +12 volts prior to the measurement by the amount of seconds specified.

+12 SWITCHED GROUND

Ground pin for Switched +12 output. It is good practice to use separate grounds for analog sensors and Switched power outputs. Never place sensor grounds on the switched 12 ground.

EARTH GROUND LUG

Always provide a heavy gauge wire to the earth ground connection. Provide a heavy copper ground stake driven in the earth with a ground strap to this terminal for a good earth return for proper transient protection.

RF POWER INFORMATION:

TRANSMIT POWER

The transmit power is factory set for all different satellite types and baud rates at the factory. The following list indicates the power during the carrier for each of the Satellite applications.

GOES 100	7 Watts
GOES 300	7 Watts
GOES 1200	14 Watts
INSAT	3.5 Watts
METEOSAT	7 Watts
FY-2	7 Watts
ARGOS/SCD-1	2.5 Watts

Note: Consult factory concerning support for satellite types above.

ADJUSTMENT OF POWER

The transmit power is set at the factory and is not adjustable by the user. Special cases may permit the adjustment of the transmit power by software, but only under the direction of the factory.

RF BOOSTER AMPLIFIERS

The use of RF booster amplifiers to increase the transmit power is strictly forbidden by any of the certifying agencies without the pre-approval of the governmental agency or the certification of the Satlink 2 combined with another amplifier.

FORWARD AND REFLECTED POWER

NOTE: The forward and reflected power measurements are only rough estimates and should not be used to calibrate the transmitter.

The Satlink 2 is equipped with a forward and reflected power measurement capability. This measurement capability is designed to assist the user during the installation and check out of a transmitter. In certain circumstances, the user may even transmit the measured power values appended to the transmission. Measurements include:

1)Forward RF power (Measured during the carrier portion of the message)

2)Reflected RF power (Measured during the carrier portion of the message)

The measurement system is not designed to be a replacement to a wattmeter, however, in the absence of a meter on hand will serve as a method to confirm that the antenna system is presenting a proper load to the transmitter. If the user has extra time in the transmission slot, this information may be transmitted as an appended value to the data content.

FORWARD POWER

The forward power is measured via a coupler placed at the RF output along with an RF detector integrated circuit. This generates a voltage that is read via an A/D circuit. The microprocessor

calculates the forward RF power based on the mathematical relationship between forward detected voltage and RF power.

    Measurement Range: 1 to 20 Watts
    Accuracy: +/- 2 dB (+/- 5 watts at 14 watts)

The forward power is measured also as part of the automatic gain control system. As the temperature changes and the power level is adjusted, the net forward power will be relatively accurate due to the stability of the measurement circuit.

REFLECTED POWER

The reflected power is also measured via a coupler placed at the RF output with an RF detector integrated circuit.   The microprocessor calculates the forward RF power based on the mathematical relationship between forward detected voltage and RF power.

    Measurement Range: 1 to 20 Watts
    Accuracy   +/- 2dB (+/- 5 watts at 14 watts)

The reflected power measurement is most accurate when the cable length to the antenna is the standard 15 foot cable. However, the measurement will function with other lengths of cables just with slightly more error. In general, a properly matched antenna will generate a returned RF power of 0 watts. Antennas that may have damaged RF cables or missing or broken elements may present reflected power in the 1 to 2 watt range. Typically it is advised to repair the cable or antenna when the reflected power exceeds 1 watt.   If for some reason the antenna cable is cut or open circuit, the reflected power will indicate nearly the full forward amount of RF power.

HOW TO MAKE READINGS

The following steps will help in learning how to make measurements:

ON SITE CHECKOUT

A station has just been installed or someone is at a site on a visit. Receiving a check of system performance would be beneficial before a person leaves a remote station. The steps are:

1. Make a transmission, either forced or scheduled.
2. Using the Satlink Communicator program, go to the "Diagnostics" Tab an click on the Transmit power button.
3. Select the "Read Power" button and the forward and reflected power will be displayed.   This readout represents the last power seen by the detector regardless of the type of transmission made, whether it is a 100/300 or 1200 bps transmission.

OVER THE SATELLITE MONITORING

A provision to append the last transmitted forward and reflected power is built into the system. A check box is provided under the scheduled transmissions tab of the Satlink communicator program for enabling the appended value.

NOTE: *The transmission will always report the forward and reflected power of the LAST transmission, not the current transmission.*

SEQUENCE:

1) A transmission is made. The first transmission will report 0.0/0.0 watts for forward and reflected power.
2) On the second transmission, it will append the value for the last transmission of the same scheduled type.
3) On the third transmission, it will append the value of the second transmission of the same scheduled type and so forth.

SPECIAL CASE HANDLING:

If the transmitter is programmed to make scheduled transmissions at 100/300 baud and random transmission at 1200 baud (or the reverse of that), then there might be some confusion as to what power level should be appended to the next message. The problem that arises is that there are different power levels for each transmission type. Satlink 2 will not mix the reporting of the scheduled and random transmission power readings. Therefore, the appended transmit power value will only show the last reading for the last transmitted scheduled transmission. So, for example if the transmitter was to alternate scheduled transmissions at 7 watts with random transmissions at 14 watts, then the only appended value will be the 7 watt value from the last scheduled transmission even though the last physical transmission was 14 watts (for random). This will prevent confusion on the decoding end as to why the transmit power was moving from between 7 and 14 watts.

OBSERVATIONS:

It is generally a good procedure not to append too many characters to the transmission as best practice is to keep the message to the minimum possible length. While it may look like there may be enough room, be certain to leave margins on each side of the message to be transmitted. It is therefore our recommendation to use this forward and reflected power reading only in cases where significant time margins exist in the transmit time slot or for short periods of time to determine the stability or to help resolve problems with the station.

DC INPUT POWER

DC input power is not critical to the transmitter as long as it remains in the range of 10.4 to 15 volts DC. The transmit power is independent of this voltage in this range thereby eliminating varying amount of watts with low battery conditions. It is important to have a well charged battery that is capable of delivering 5 amps without significant sagging under the load during the transmission. The transmission will abort if the voltage drops below the 10.4 volts, the range in which the battery is considered failed. The Satlink 2 will continue running without transmitting well down to the 7 or lower volt range.

Chapter 4 Understanding Satlink Logger Operations

OVERVIEW

This chapter presents the internal mechanics of the software that runs Satlink Logger.   It also describes the principles the user should keep in mind when setting up the logger. All details of *how* to setup the logger are presented in the chapter titled "Using Satlink Logger Communicator".

The software is composed of two main parts: the self-test bootloader and the main application. The self-test can be invoked at startup (see the Self-Test section of the Maintenance chapter). The main application is responsible for Satlink's day-to-day operations. It runs under a multi-tasking operating system that allows Satlink to perform measurements and transmissions on independent schedules.

What Satlink Front Panel Lights Indicate

There are three LEDs on the front panel of Satlink. When power is applied to Satlink, all three lights will come on in sequence, indicating that Satlink has booted. Afterwards, one of the following scenarios will occur:

- Green light blinks once every five seconds – this is the desired state. It means Satlink is up and running, making measurements and transmissions depending on the setup.
- Yellow LED blinks every 10 seconds – Satlink has not been setup. It is stopped and will not make transmissions or measurements. To correct this, connect to Satlink via the Communicator program, set it up, and hit Start.
- Yellow and green LEDs blink every 5 seconds – Satlink is running but is having GPS trouble. If the yellow light does no go away after two or three minutes, recheck the GPS antenna and make sure it is properly connected and that it has good view of the sky.
- Yellow blink every 5 seconds. – Satlink is stopped, and the GPS does not have satellite lock (see the two cases above)
- Yellow light blinks twice in a row every two seconds – this is bad. Satlink thinks it is malfunctioning. Either it has bad hardware, is unable to transmit or some other failure. Connect to Satlink with the Communicator program, and the details of the failure will be revealed. Once the problem is fixed, the blink should go away.
- Red LED is on solid – Satlink is transmitting (there is power being output through the RF connector).
- Green light is on solid – Satlink is getting ready to transmit. You should see the red light come on soon.
- Green light blinks twice – Satlink is making a measurement.
- Green and yellow LEDs are blinking madly – Satlink's software is being upgraded.

Running and Stopped

Satlink Logger has two operating modes: running and stopped. If you are using Satlink Transmitter version 4.11 or older, none of the following apply.

A **stopped** system is Satlink in an idle state, awaiting user input. In this state, Satlink is ready to be configured for operations. Transmissions and measurements can be set up in this mode. Test transmissions and measurements can be initiated by the user to demonstrate that the system is operating properly.

A **running** system is a configured system that is making measurements and transmissions. An operational Satlink is expected to be left in running mode. Most configuration settings *may not* be changed while the system is running.

Upon power up, Satlink will attempt to resume the state if it had last: if it was running when power was turned off, it will attempt to start running when power is next applied. If Satlink was stopped when power was taken away, it will be stopped when it is next powered. This behavior was introduced with Satlink version 5.04. Satlink's older than 5.04 had an **autostart** option – whether it was selected or not determined whether Satlink would go into running or stopped mode upon bootup.

The red LED on the front panel will indicate that Satlink is stopped by blinking once every 10 seconds; a running system will flash the LED every 5 seconds.

Satlink will refuse to start if it has any invalid settings or if it is in the course of a transmission.

Configuring Satlink Logger

When configuring Satlink logger, the user is expected to follow these steps:
1. Set the system to defaults. If this is a brand new unit, the unit should already be in this state. If not, the user can set the system to factory defaults using the Communicator program (Diagnostic tab of the Communicator program).
2. Set up Satlink's configuration: This involves setting the measurement types and schedules, as well as transmission interval, times, and satellite ID. The details of setup are described in the chapter titled "Using Satlink Logger Communicator".
3. Each part of the setup should be tested. If sensors are connected, measurements should be tested by forcing a measurement and by examining the results.   A transmission should also be forced. Make sure to transmit into a dummy load – not on air.   Monitor Satlink's status to ensure that it reports a successful transmission.
4. Start Satlink, just to ensure that the setup is proper. If the setup is invalid or incomplete, Satlink will notify you of the problem. Otherwise, it will go into running mode.
5. If the user is at the site where Satlink will be left to operate, leave the Satlink running. If not, power down Satlink. If Satlink is running when powered off, it will resume running when power is next applied.

Understanding Transmisssions

Each transmission consists of several phases. Scheduled transmissions must occur at designated times. Prior to this designated time is when preparation for the transmission must commence.

The first phase of the preparation is GPS satellite acquisition. The GPS needs to be turned on early enough to allow for satellite acquisition, which takes a variable amount of time (the time depends on weather and the position of the GPS satellites). The maximum amount of time given to the GPS is user settable. Satlink is set up for redundant GPS satellite acquisition: should one acquisition fail, the system will fall back on the previous one and continue with the transmission. In any case, if GPS fails to acquire satellites, Satlink will have the GPS retry several times. In the unlikely event of repeated GPS failures, try increasing the satellite acquisition time. The most likely thing to cause GPS failures is GPS antenna obstruction (such as snow covering the antenna).

The second phase of the preparation is referred to as the frequency discipline. It ensures that Satlink transmits exactly on frequency even under the harshest of temperature conditions.

The third phase involves encoding data from sensors connected to Satlink. In this phase Satlink prepares data which has previously been collected. Make sure to set up your measurements

such that they take place prior to transmission (three minutes prior to transmission should be a safe time). This way you ensure that the most current data will be transmitted.

The next phase involves preparing data, which has been given to Satlink by another logger (such as Sutron's 8210 Data Recorder).

The last phase has Satlink turn on the RF hardware, which will send the transmission.

Data Buffers

Satlink Logger's data merge capability allows Satlink to handle two kinds of transmission data. External data is data given to Satlink from another device (such as Sutron's Xpert data logger). Sensor data is data collected by Satlink from sensors directly connected to it.

External data has its own buffer. This buffer is large enough to handle the maximum amount of data that can be sent in a single transmission (12 kilobytes). Satlink will automatically empty this buffer after a transmission, unless the Circular Buffer option (Advanced Scheduled Tab of the Communicator program) has been selected, in which case any unsent data gets kept for the next transmission. The user may limit the amount of data that gets sent by using the Window Centering (Scheduled Tab of the Communicator program) option. The buffer will also get emptied when the user starts Satlink, and upon power up.

External data should be given to Satlink about 60 seconds prior to transmission. If there is a desire to give the data closer to transmission, Satlink needs to be asked until when data is accepted into the buffer. There exists a command that can be sent to Satlink via the serial port to find out just how close to a transmission the data can be given. If the data is given too late, it is sent in the next transmission.

Sensor data gets stored in a buffer that holds the last 32 readings of each of the 10 measurements. This data gets lost upon power up.

Both External and Sensor data are available to the user for inspection. Satlink is also able to show the user what a transmission message will look like. Please refer to details on page 72 to find out how to inspect Satlink's data buffers.

Understanding Measurements

Satlink Logger is capable of making multiple measurements each of which has an independent schedule. When more than one measurement is scheduled to occur at the same time, the following will happen:

- If all the measurements are different from each other (they require talking to different sensors), they will happen in sequential order, starting with measurement index 1. For example, if measurement 1 is set to talk to an SDI-12 sensor, and measurement 2 is set to talk to a tipping bucket, when it is time to collect data, the SDI-12 measurement will be made, and once it is complete the tipping bucket measurement will be made.
- If two measurements use the same reading, then only one reading will be made, and the two measurements will be calculated from the same reading. For example, if there are two tipping bucket measurements scheduled for the same time but with a different slope and offset, only one reading of the tipping bucket will be made. Another example may have an SDI-12 sensor that returns two parameters in one reading. One measurement would be set to parameter 1, and the other to parameter 2. Assuming both measurements are scheduled to occur at the same time, when time for measurement came, one reading would be made from the SDI-12 sensor, and both measurements would be calculated from that reading.

If the user wanted to set up a station that would log rainfall once an hour and that would have an alarm checking rainfall every five minutes, the following setup would be appropriate: both measurements would be set up to be tipping buckets.   One measurement would be set up to an interval of one hour; it would also be set up to log and to be included in scheduled transmissions. The other measurement would not be set up to log; it would be set to an interval of five minutes and it would be set to be included in random transmissions.

SDI Clock Synchronization

Certain Sutron SDI-12 sensors (such as the SDR, RLR, and the CF Bubbler) support a command which is used to set the time of the sensor. Satlink takes advantage of that feature, and periodically sets the clock of the sensor, ensuring that the accurate time provided to Satlink by GPS is shared with the sensors.

When started, Satlink will send an identify command to all the SDI devices that Satlink has been setup to measure. Any device that responds with SUTRON in the reply will have the read time XDT command issued to it. All devices that correctly reply will have thier time set by Satlink. Satlink will send the set time command to the sensors when Satlink is started and every 24 hours thereafter.

The set time command takes the format **aXDTYYYY/MM/DD HH:MM:SS!**

a is address
XDT is the command to set the date and time
YYYY is the year
MM is the month (01 to 12)
DD is the day of the month (01 to 31)
HH is the hour (military time 0 to 23)
MM is the minutes
SS is the seconds

Example set date time command:
0XDT2005/09/01 13:15:00!

System Malfunction

As a part of the status, Satlink reports whether the system is malfunctioning. Any of the following symptoms cause Satlink to consider itself 'malfunctioning':
- System failed to autostart.
- Failed last two consecutive transmissions.
- Failed last two consecutive readings of any single measurement.
- Failed at least 25% of all transmissions (if the system has made more than a total of 4 transmissions).
- Battery voltage low.
- Failsafe tripped.

A malfunctioning Satlink will blink red heartbeat LED every 2 seconds.

Chapter 5 Using Satlink Logger Communicator

OVERVIEW

Satlink Logger's visual interface program, referred to as Satlink Logger Communicator, is a Windows program that gives you the ability to configure a Satlink Logger transmitter. A separate program that runs on Pocket PC platforms (e.g. the HP *iPaq*) is also available from Sutron. This latter program is referred to as *SatComm*. You will need either the Satlink Logger Communicator version 3.0 (or above), or SatComm version 1.0, to be able to talk to Satlink Logger (and SatComm version 2.0 or above to speak to Satlink 2).

Satlink Communicator will work with Satlink transmitters version 4.11 or older. However, not all of the features will be available (namely measurement and logging) and some controls will be inaccessible. SatComm will work with Satlink loggers version 5.0 and above.

The setup consists of information such as the measurement setup, logging setup, the assigned transmission ID, transmission time, and interval. Satlink Logger stores this configuration into permanent memory so that once configured, it will remember the configuration and restore it each time it is powered up.

Satlink Logger's visual interface program is not needed if you are using Satlink Logger as just a transmitter and are connected to an advanced data recorder such as Sutron's Xpert or 8210. These data recorders have built-in programs that can set up a Satlink Logger transmitter. Refer to Appendix A if you are using Satlink Logger with the 8210 or Appendix B if you are using Satlink Logger with the Xpert. However, you should still familiarize yourself with the Satlink Logger Communicator program.

Understanding Satlink Setups and How Communicator Talks to Satlink

A setup is a collection of settings used to configure Satlink. Satlink's setup is composed of settings such as transmission time and interval, satellite id and measurement type. Using the Communicator program, setups can be saved and loaded to and from files. The Communicator program can also read and write the setup from and to a connected Satlink.

It is possible to work on a setup without being connected to Satlink. The user may configure a setup and save it to file. Once Satlink is connected, that and any other saved setup may be sent to Satlink, thereby configuring it.

When making changes to the setup in the Communicator program, no communication will take place with Satlink until the user chooses to send setup to Satlink. So, if the user disconnects Satlink before sending the setup to Satlink, Satlink's setup will not have changed.

IT IS NECESSARY THAT THE SETUP BE SENT TO SATLINK BEFORE DISCONNECTING.

Communicator (PC) Startup screen

When the Satlink Logger Communicator program starts, the user is greeted with the following window:

"Connect to Satlink" will cause the program to attempt to find a Satlink Logger on one of its serial ports. See "Find Satlink", later on in this section, for more information on searching the serial ports. Once a Satlink has been found, the Communicator program will load that Satlink's setup to the visual interface.

"Dial Satlink with modem" should be selected to remotely connect to Satlink via the phone.. Please refer to the modem section of the manual on page 40.

"Work disconnected from Satlink" will cause the program to work in disconnected mode, meaning a Satlink Logger does not need to be attached. The user can prepare setups and send them to Satlink at a later time. Once the program is started, the user can elect to change the working mode from the options menu.

"Do not show this form on startup" is an option that allows the bypassing of this first window. It may be later changed from the options menu.

Satlink Logger Quick View Status (PC Only)
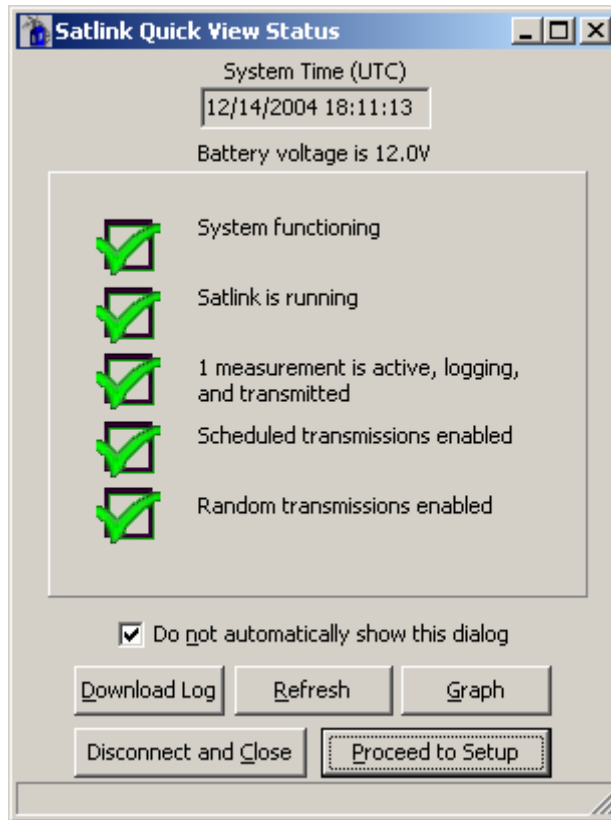
The intent of the Quick View Status window is to give the user a means of easily determining whether a Satlink is functioning properly. In addition, it allows the user to, with a single click, download Satlink's log.

Icons are used to tell the user whether Satlink is working. There are three different kinds of pictures

This picture indicates a good state.

This picture indicates a bad state.

This picture indicates a "maybe" state which may either be intended by the user, or it may be that Satlink was not setup properly. In any case the user should make sure that the setup is what he intends.

There are five standards which are presented as pictures:
- System functioning - Any of the following symptoms cause Satlink to consider itself 'malfunctioning' and display a bad icon:
  - System failed to autostart.
  - Failed last two consecutive transmissions.
  - Failed last two consecutive readings of any single measurement.
  - Failed at least 25% of all transmissions (if the system has made more than a total of 4 transmissions).
  - Battery voltage low.
  - Failsafe tripped.
- System running – if the system is stopped, a bad icon will appear.

- Measurements active and logging. If Satlink has at least one measurement active and logging, a good icon will appear. Otherwise, a maybe icon will appear.
- Scheduled transmissions need to be enabled in order for a good icon to appear; otherwise a maybe icon appears.
- Random transmissions being enabled will cause a good icon to appear.

Hitting the "Download Log" button will download all the data logged since the last download, and save it to a default file name which consists of the station name and the current date. After the download is complete, the user is told what file the log was saved to.

The "Graph" button will bring up a graph representing the last 32 readings of each active measurement. For more information please see the graphing section on page 66.

The "Refresh" button is used if the user connects to a different Satlink.

"Close Communicator", if pressed, will exit the program without further ado.

"Proceed to Setup" will take the user to the rest of the Communicator program.

The "Do not show this dialog on startup", if checked, will not show this dialog when the Communicator is started. Once selected this option can be changed from the Options menu in the main window.

The Quick View Status dialog can be displayed from the tools menu, or via a button from the main tab.
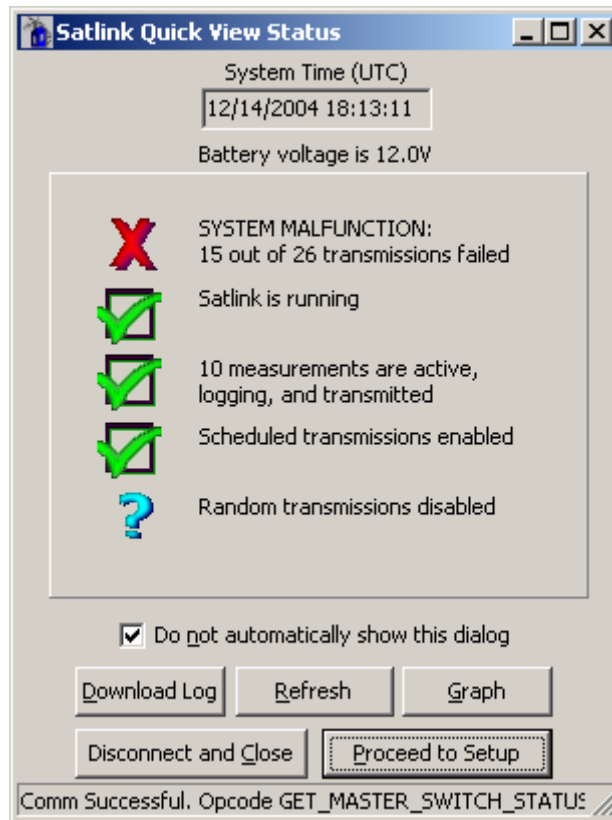
The picture above is what a malfunctioning Satlink would report.

The Communicator's main screen looks like this:
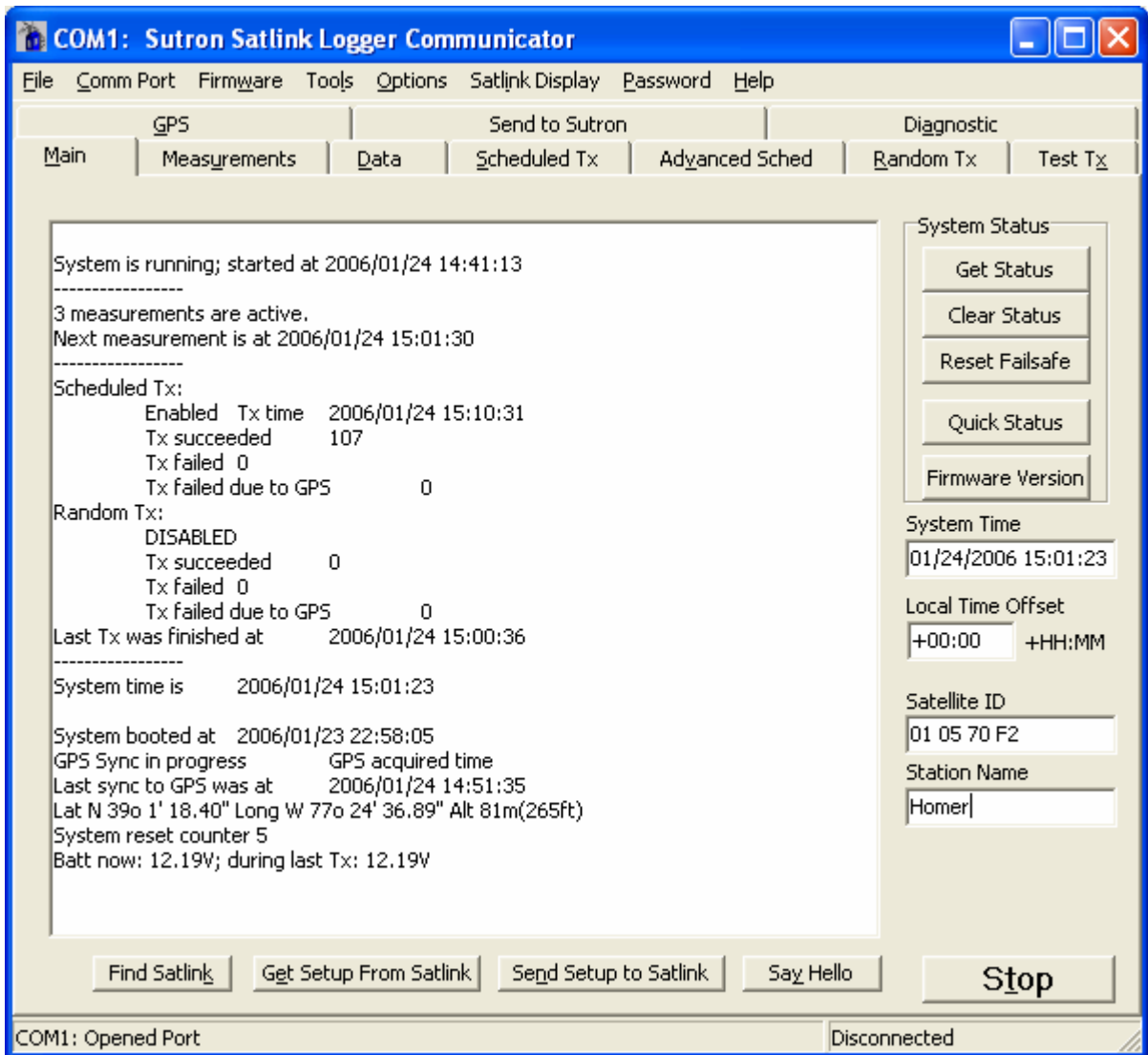
Across the top of the screen are the menus for the program: File, Comm Port, Firmware, Tools, Options, Satlink Display, Password, and Help. Under these menus are the tabs for the main parts of the setup program. These tabs are Main, Measurements, Data, Scheduled Tx, Advanced Scheduling, Random Tx, Test Tx, GPS, Send to Sutron, and Diagnostic. Each of these tabs is described in the following sections.

Notice the buttons at the bottom of the display. The buttons are labeled "Find Satlink", "Get Setup from Satlink", "Send Setup to Satlink", and "Say Hello". The last button is labeled either "Start" or "Stop". Pressing Hello simply sends a message to Satlink Logger and reads the reply. This is a simple test to make sure the program is communicating with Satlink.   You should see in response the simple message:

Whenever the PC communicates with Satlink Logger, the software will display this dialog box.

This indicates that the program is either sending information to Satlink Logger or retrieving information from Satlink Logger. Since the dialog box is removed when communications are complete, the box may appear to flash onto the screen.

The "Find Satlink" button causes the program to search through all its serial ports for a Satlink Logger. If you connect a Satlink Logger to the PC after the program is already running, you may need to press "Find Satlink" in order to communicate with it. If the Communicator Program finds a Satlink Logger it will display this dialog:
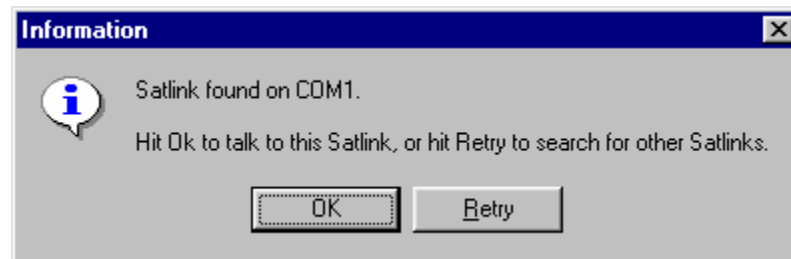
If multiple Satlinks are connected through the serial ports, the retry button will search for other units. In this way the user can switch between units using one program. It is also possible to open multiple instances of the Communicator program to talk to these units individually.

The "Get Setup from Satlink" button retrieves Satlink's current setup and displays it in the Communicator program, where it can be modified or saved to a file, without affecting Satlink.

The "Send Setup to Satlink" button will store the setup that is currently in the visual interface to the connected Satlink Logger. **The setup cannot be sent while Satlink Logger is running.** Also, if a transmission is in progress, Satlink will refuse to take a setup.

If Satlink Logger is running when the setup is sent by the Communicator program, the following dialog will appear.

Sending Setup to Satlink

Satlink is currently running. In order to send the setup, Satlink must first be stopped. Do you wish to...

- ○ STOP the system and SEND the setup.
- ○ STOP the system, SEND the setup, then START the system.
- ○ Do NOT stop, do NOT send setup.

OK
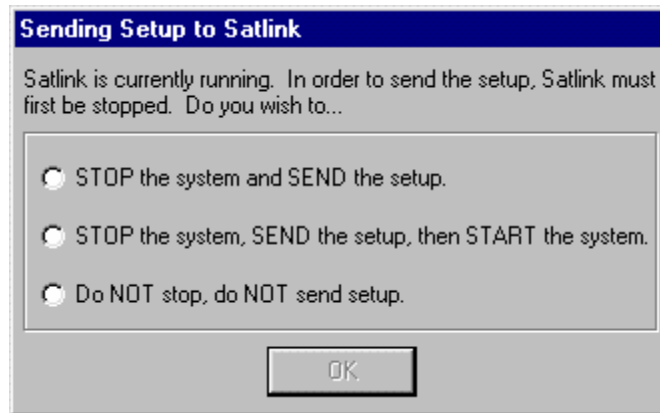
The first choice will leave the system stopped after sending the setup, while the second will start the system again afterwards. The third choice will cancel and not send the setup.

The "Start" button is used to start the system. When a start is requested, Satlink Logger will make validation checks of all its settings. If any setting is found to be invalid, Satlink Logger will refuse to start and will notify the user which settings need to be fixed. The system cannot be started while Satlink Logger is transmitting, or during a user initiated transmission.

Note that the "Start" button is not always visible in SatComm as it is in Communicator. The Start button appears only the Main page in SatComm.

If you are running Satlink transmitter version 4.11 or older, there will be no start stop button. Instead, there will be a "Finalize" button, which, when pressed, will check Satlink's setup to verify that it is valid.

Once the system is running, the following will happen. If scheduled transmissions are enabled, they will happen at the set interval. Random transmissions, if enabled, will react to alarms and make transmissions at the proper interval. Measurements, if made active, will take place periodically according to their interval. A running system will not allow for setup changes nor user initiated scheduled transmissions to be made, so the Communicator Program will prompt the user if it needs to stop the system.

The "Stop" button halts any transmissions or measurements on a schedule. While the system is stopped, the user can send the setup from the visual interface to Satlink. If the system is halted after a critical stage in a transmission is reached, the transmission will go through regardless of the system being stopped. This critical stage is a little while before the actual transmission is set to occur.

For more information refer to the section titled "Running and Stopped" in Chapter 4.

Communicator (PC) Menus

Communicator's menu options are "File", "Comm Port", "Firmware", "Tools", "Options", "Satlink Display", "Password", and "Help".

The "File" menu offers several options . "New", "Open", "Save", and "Save as" all refer to the setup. Select "New" to put all the settings to their default value. "Open" will open a previously saved setup. "Save" and "Save As" allow the user to store the setup in a file. None of these options will cause the Communicator to talk to Satlink.

The "Export" option allows the user to save Satlink's status and/or setup in easy to read, ASCII format. The setup and/or status can be saved to file, copied to the clipboard, or sent to the printer. Depending on what tab is selected, this option captures either the contents of the Main tab's status window, the GPS tab's status window, or the Debug output window.

"Setup Printer" allows the user to configure which printer to use for the "Export Setup" and "Export Status" options.

The "Comm Port" menu will allow the user to select, to open, and to close the communications port. The "Search Ports for Satlink" menu item has the same effect as hitting the "Find Satlink" button: it searches all the ports on the PC and attempts to contact Satlink Logger through them. Selecting "Modem" from the menu will bring up a window which can be used to dial to a remote Satlink using a phone modem. More details on using a modem to connect to Satlink can be found on page

The "Firmware" menu allows the user to check the current version of the main application code running in Satlink Logger. Upgrading the firmware can also be accomplished by using this menu. To upgrade the firmware, the user will need a ".upg" file provided by Sutron. Please refer to the section entitled "Upgrading Satlink Firmware" on page 88.

The "Tools" menu contains the commands "Get Setup from Satlink" and "Send Setup to Satlink". These options either load the setup to a Satlink or from the Satlink. They work the same as the buttons at the bottom of every tab. After making changes to the setup, make sure to send setup to Satlink.

Selecting "Quick Status" from the menu shows the Quick View window that reports Satlink's status. Option "Export Log" allows the user to download Satlink's log (more information in the Data Tab section).   "Graph Data" will bring up a graph of user selected data gathered by Satlink.

The "Options" menu allows the user to enable/disable the auto-updating feature of the program. Auto updating is responsible for periodically updating the "System Time" field, the status window on the Main tab, and the status window on the GPS tab. If you find that the auto-updating makes it hard to read the status, disable it using this feature.

The option labeled "Debug Info in Separate Window" allowed through this menu has to do with the displaying of debug information and is explained later in this document, in the Diagnostic section.

If "Work Connected" is checked, Satlink Logger will refresh the data on the Main, Data, and GPS pages every time they are accessed. Disabling this will prevent the Communicator Program from trying to talk to the Satlink Logger. If you wish to manipulate setups without talking to Satlink, deselect the "Work Connected".

"Satlink Display" offers several options for configuring Sutron's Satlink Display product. A Satlink Display is an optional hardware accessory to Satlink that incorporates an LCD display used to view and setup Satlink.   The Display also facilitates modem operation and may even include a built in modem.

"Password" offers a means to manage Satlink's password protection. Please visit the password section on page 37 for details.

The "Help" button allows the user to find out the current version of the Communicator Program that is running, and it also provides a link to Sutron's website.

Password Protection

Introduced in version 6.12, password protection allows the user to deny access to those without a password. By going to the password menu and selecting "Settings", the following dialog shows up:
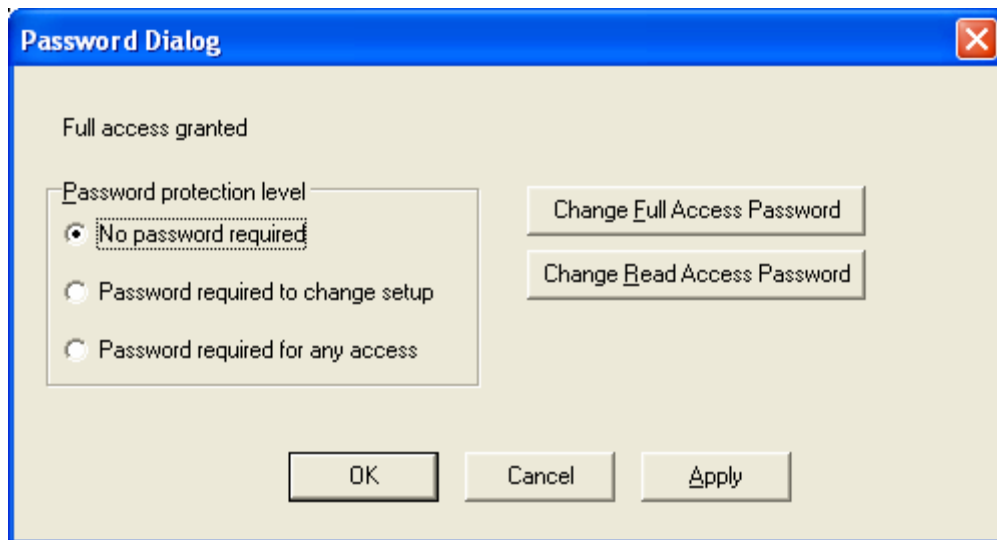
If enabled, Satlink offers two levels of password protection.
If "Password required to change setup" is selected, a user without a password can see Satlink settings and data, but is not allowed to change setup or start/stop Satlink. If a user attempts to change setup, he is prompted for a password. The user must then enter the full access password in order to be granted access to change setup.
If "Password required for any access" is selected, than a user without a password cannot access Satlink at all. A user who logs in with the read access password will be granted read-only access but will not be allowed to change setup. A user who logs in with the full access password will be granted full access.
Do not forget to set passwords before enabling protection!

SatComm (PocketPC) Specifics

SatComm operates with Satlinks that are version 5 or higher.

Before installing SatComm, if a previous version is already installed, uninstall it.

SatComm Startup and Operation

When SatComm is first run, the software attempts to communicate with Satlink to retrieve the current status and display it in the Main view. If SatComm and Satlink are communicating, you should see the current system status, station name and ID on the display. If you are not connected to Satlink, or if there was a problem with the communications, the message "Communications with Satlink failed, Please check connections", will appear in the Status box. Connected or not, you will be able create or edit the Satlink setup stored locally on the handheld using the SatComm program.

After SatComm is started, it's setup represents whatever setup file was last used. This, of course, may not represent the setup of the connected Satlink. To synchronize the setup to the connected

Satlink, select "Tools – Get from Satlink." As changes are made to the setup, these changes are not actually loaded into the connected Satlink until the setup is sent to Satlink using "Tools – Send to

Satlink". Hence, the usual procedure for using SatComm with a Satlink is to first get the setup, make desired changes, and then send the modified setup to Satlink.

A possible exception to the procedure above would be when you need to load a setup configured off-line into one or more Satlinks. In this case, you would just connect and send the setup. Note that when you want to copy setup files to a pocket PC running SatComm, the correct directory destination is "My Documents\SatComm". Satlink setup files have the extension ".sls".

SatComm Menus

SatComm's menu options are "File", "View", "Tools", and "Options".

The "File" menu offers "New", "Open…", "Save As…", and "Exit".   Select "New" to set all settings on the hanheld device to their default value. "Open" will open a previously saved setup. "Save As" allows the user to store the setup in a file. Note that there is no "Save" option. This is because SatComm, like most Pocket PC applications, saves all settings as they are changed. Since changes are saved automatically, use the "New" command with care since all settings of the current file will be reset, with no chance to undo.   "Exit" is used to terminate the SatComm program.   Pressing the "X" button in the upper right of the display only hides the SatComm appplication; it does not close the application (freeing memory and the comm port). The only way to stop and close the program is to use the "File", "Exit" menu item.

The "View" menu is used to select the page to view. A check-mark appears by the page currently selected. The supported views are: Main, Measurements(1), Measurements(2), Data, Scheduled Tx, Adv Sched Tx, Random Tx, GPS and Test. These views provide roughly the same functions available on the tabs of the PC Communicator program.

The "Tools" menu contains the commands "Send to Satlink" and "Get from Satlink". These commands either send the setup to a Satlink or get it from a Satlink. Since changes are saved automatically, use the "Get from Satlink" command with care since all settings of the current file will be set to the values from Satlink, with no chance to undo.

The "Reset to factory defaults" command on the "Tools" menu commands the Satlink to set its settings to the pre-programmed factory defaults. This command does not set the local file settings to the same as those in Satlink. If this is desired, follow the command with a "Get from Satlink" command.

The "Tools" menu command "Get Satlink Version" displays a dialog containing the version of the firmware as reported by Satlink. The "Upgrade firmware…" command allows you to select an upgrade file to upgrade Satlink firmware.

If you are connected to a Satlink Display, you can use the "Tools" menu command "Get Display Version" to display a dialog containing the version of the display firmware. The "Clear Display password" command allows you to clear the password currently set in the Display. The "Upgrade Display…" command allows you to select an upgrade file to upgrade the Display firmware.

The "Options" menu command "Satlink Connected" allows you to select whether you are connected to a Satlink. If "Satlink Connected" is checked, SatComm will refresh the data on the Main, Data, and GPS pages every time they are accessed. Unchecking "Satlink Connected" will prevent SatComm from trying to talk to Satlink. If you wish to manipulate setups without talking to Satlink, deselect "Satlink Connected". This happens automatically when a communication failure occurs.

The "Bluetooth Mode" command on the "Options" menu allows you to specify whether SatComm is using Bluetooth to talk to Satlink. When communicating to Satlink via bluetooth, the baud rate cannot increase from 9600 during firmware upgrades and/or log downloads.

The "Set Comm Port…" command on the "Options" menu allows you to set which com port to use to talk to Satlink.

Using a Modem

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With the introduction of Satlink software version 6.07, Satlink has been able to talk via Modem. Satlink can be contacted by dialing though the Communicator program. Satlink cannot dial out on its

own. In order for modem communication to work, Satlink must be connected to a modem which is setup to auto-answer. To setup a modem to auto-answer, issue it the ATS0=1 command. In addition,

the PC on which the Communicator is run needs to have a modem.

The following window can be shown via the Comm Port, Modem menu. If your modem is properly configured, simply enter the phone number that Satlink is connected to and hit the "Dial" button. Be patient while Communicator establishes connection. Status updates will appear in the status bar.

Once a connection is established, the Modem window will close and the Main window will appear. Changing setups, downloading logs, and just about everything that can be done via direct connection can be done via modem connection. **Upgrading via modem is not recommended** as poor line quality may result in a botched upgrade and a dysfunctional Satlink. Once the connection is complete, select "Hang up" from the Comm Port menu, the Modem window, or close Communicator.

The advanced options of the Modem window can be used to configure a modem. Click the "Advanced" button to have all the options appear.   The option to "Set modem to factory defaults" should be checked unless a special configuration has been placed into the modem. The "Modem Initialization" entry can be used to send a command to the modem prior to every connection. If direct access to the modem is desired, type an AT command in the "Data to be sent" entry and click the "Send" button. The modem's response will appear.
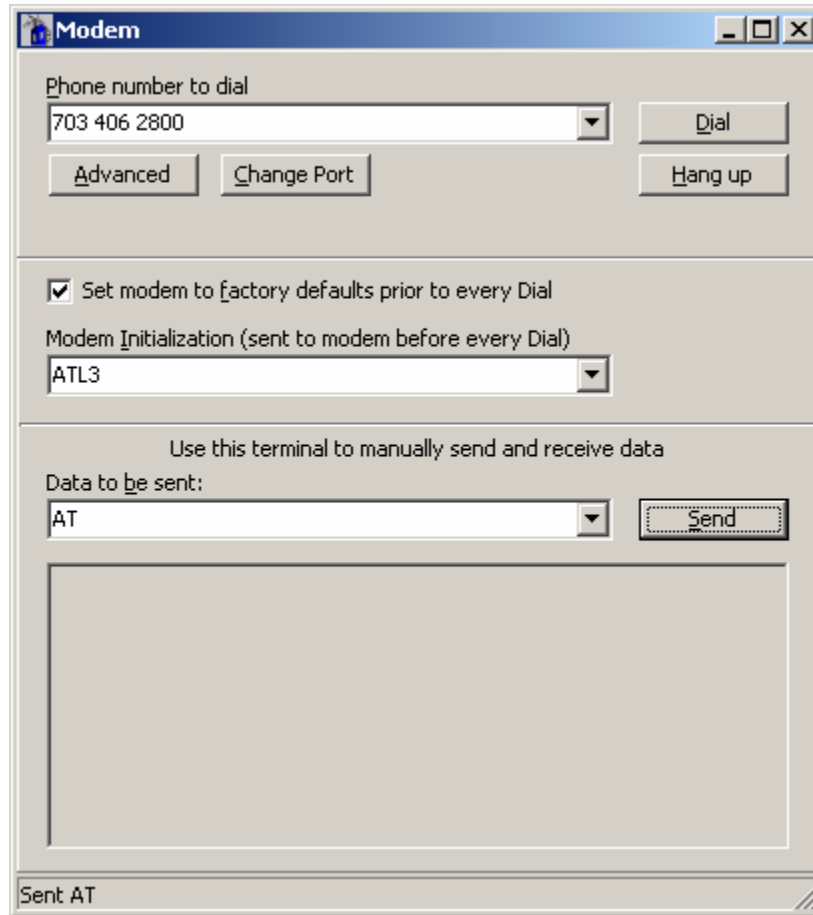
Using Bluetooth

Many Pocket PC handheld computers have Bluetooth wireless communication capability built-in. With the addition of a Bluetooth serial adapter (e.g., the Socket-brand Cordless Serial Adapter), this allows SatComm to communicate with Satlink wirelessly. Some bluetooth serial adapters look to pin 9 to provide a 12V power source. Satlink 2 provides this power.

Since baud rate cannot be renegotiated during operation, the "Bluetooth Mode" option under the Options menu must be selected.

Typically, the serial adapter must be configured for use as a serial-line replacement. This means connecting the adapter to a host PC and running a program to configure various settings: 9600 baud, a device name of your choosing, device roll = acceptor, connectable = on, discoverable = on, notifications = off, and no security.

On the Pocket PC handheld, you typically need to turn bluetooth on before you start SatComm. After turning bluetooth on, start SatComm and then use the 'Set Comm Port" option under the "Options" menu to set the com port to the one associated with bluetooth on your particular device. The bluetooth port number varies across Pocket PC devices, but is typically found by looking in the "Bluetooth Settings – Serial Port" menu. Use the port identified as the "outbound port". When the correct port is first used, the Pocket PC Bluetooth Manager will open and prompt you to select the bluetooth device you want to talk to. Select the serial adapter you configured for use with Satlink.

Using SatComm with Optional Serial Cards

It is often desireable to use one of several optional serial cards with a Pocket PC device in order to leave the main device connector free, or when the main connector does not readily offer a com port. For example, many Compact Flash serial I/O cards exist that turn a Compact Flash slot into an RS-232 com port. Typically, these devices require that a device driver be installed before use. However, once this driver is installed, it is a simple matter of selecting the correct com port from SatComm's "Options" menu to use one of these cards to communicate with Satlink.

SATLINK 2 LOGGER AND TRANSMITTER OPERATIONS & MAINTENANCE MANUAL

MAIN

The Communicator Main tab and SatComm Main page display system status and information about the transmitter. Images of the tabs are shown below.
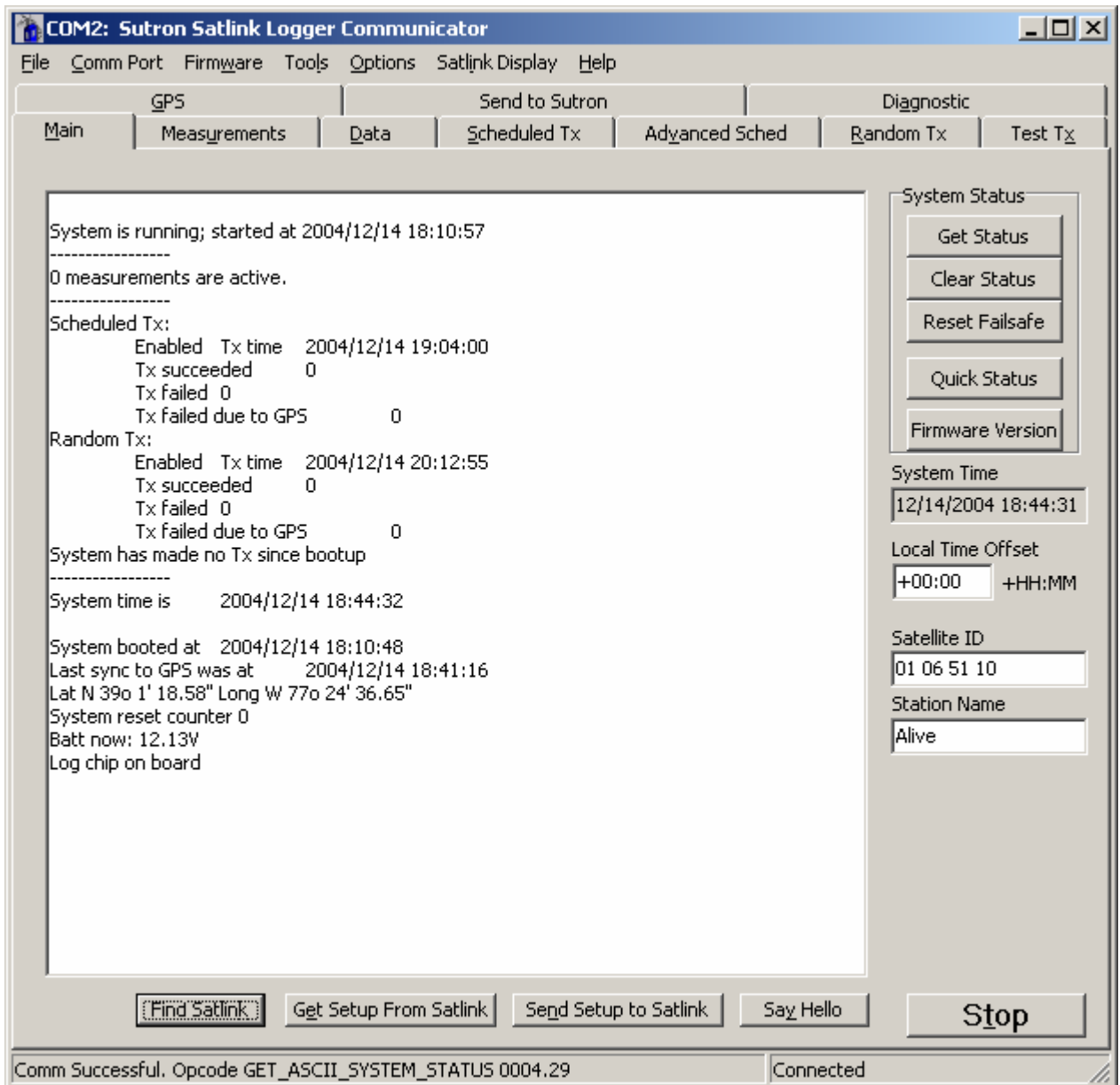
The right side of the Communicator window shows the System Date and Time, Satellite ID, and Station Name. The name is only used as an aid to help identify the station. The Satellite ID is the identifier that is transmitted through the satellite to identify each message sent.

The field labeled "Local Time Offset" ("LTO" in SatComm) can be used to have Satlink use local time instead of UTC. Enter the offset from UTC in hours and minutes to have Satlink use local time. Leave the setting at zero to have Satlink use UTC. E.g. to have Satlink run on US Eastern Standard Time, enter -05:00, indicating that EST is 5 hours behind UTC.
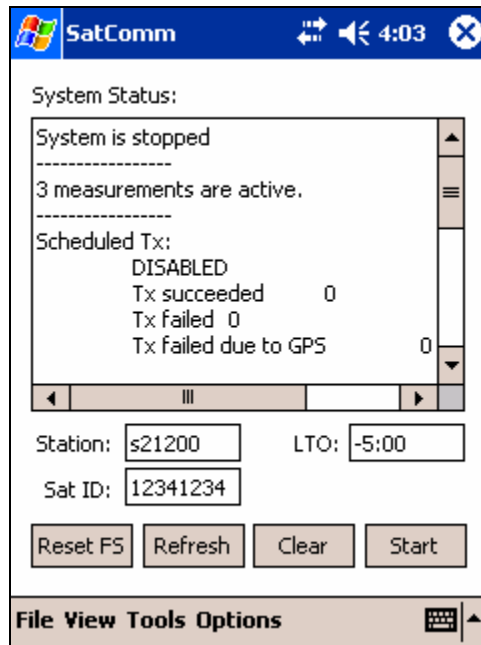
Get Status/Refresh

The "Get Status" button ("Refresh" in SatComm), retrieves from Satlink Logger important information on how the unit has been operating. The status includes information on measurements, scheduled transmissions, random transmissions, general system information and GPS information.

It is important to check the status information for errors. Look for failed transmissions, failsafe problems or system errors. Some errors can be caused by improper setup. If you suspect Satlink Logger is set up properly and not operating, contact Sutron customer service for assistance. All the statuses and errors are described in the chapter titled "Maintenance and Troubleshooting".

If the "Enable Auto Update" feature in the options menu is checked, the status will be updated every five seconds, and the clock will be updated once a second.

All the times for Satlink Logger are in the format of YYYY/MM/DD HH:MM:SS and are based on UTC (Universal Coordinated Time).   YYYY means four digits that indicate the year. If the user has entered a Local Time Offset, then Satlink keeps local time. Otherwise, Satlink runs on UTC time.

Clear Status

The "Clear Status" button ("Clear" in SatComm) sends a command to Satlink Logger to clear its status. This will clear its transmission counters and other useful information.

Reset Failsafe

Satlink Logger maintains an independent failsafe circuit designed to prevent transmissions in a malfunctioning unit. For example, if Satlink Logger were to leave the transmitter on for more than the allowable time, the failsafe would trip. It would also trip the failsafe if it tried to make two transmissions without enough time in between them. Sutron has designed the system so that the failsafe will not trip under normal operating conditions or under faulty setup conditions. The only time the failsafe will trip is when the unit has malfunctioned or under certain low battery situations. The failsafe is a redundant system independent of the main application both in hardware and in software.

The "Reset Failsafe" button ("Reset FS" in SatComm) can be used to reset the failsafe if it is tripped. Another way to reset the failsafe is to press the failsafe reset button on the side of Satlink Logger. Before resetting the failsafe, determine if the reset was due to low battery conditions and correct the

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condition. If the failsafe tripped for any other reason, you should contact Sutron customer service for assistance.

Quick Status

This button brings up the Quick View Status dialog which is described in its own section.

Firmware Version

The firmware version button displays the version of the software running in Satlink Logger. From time to time, Sutron will release a new version of the software. See the Menu section of this manual for instructions on how to update the software in Satlink Logger. You can tell what version is running in your unit using this button. Software version of Satlink Logger, Satlink bootloader, GPS module and the PIC are displayed with this feature.

MEASUREMENTS

The Communicator's "Measurements" tab and SatComm's "Measurements (1)" and "Measurements (2)" pages appear below. These allow the user to configure measurements, set the tipping bucket count, and output SDI commands on the SDI bus.
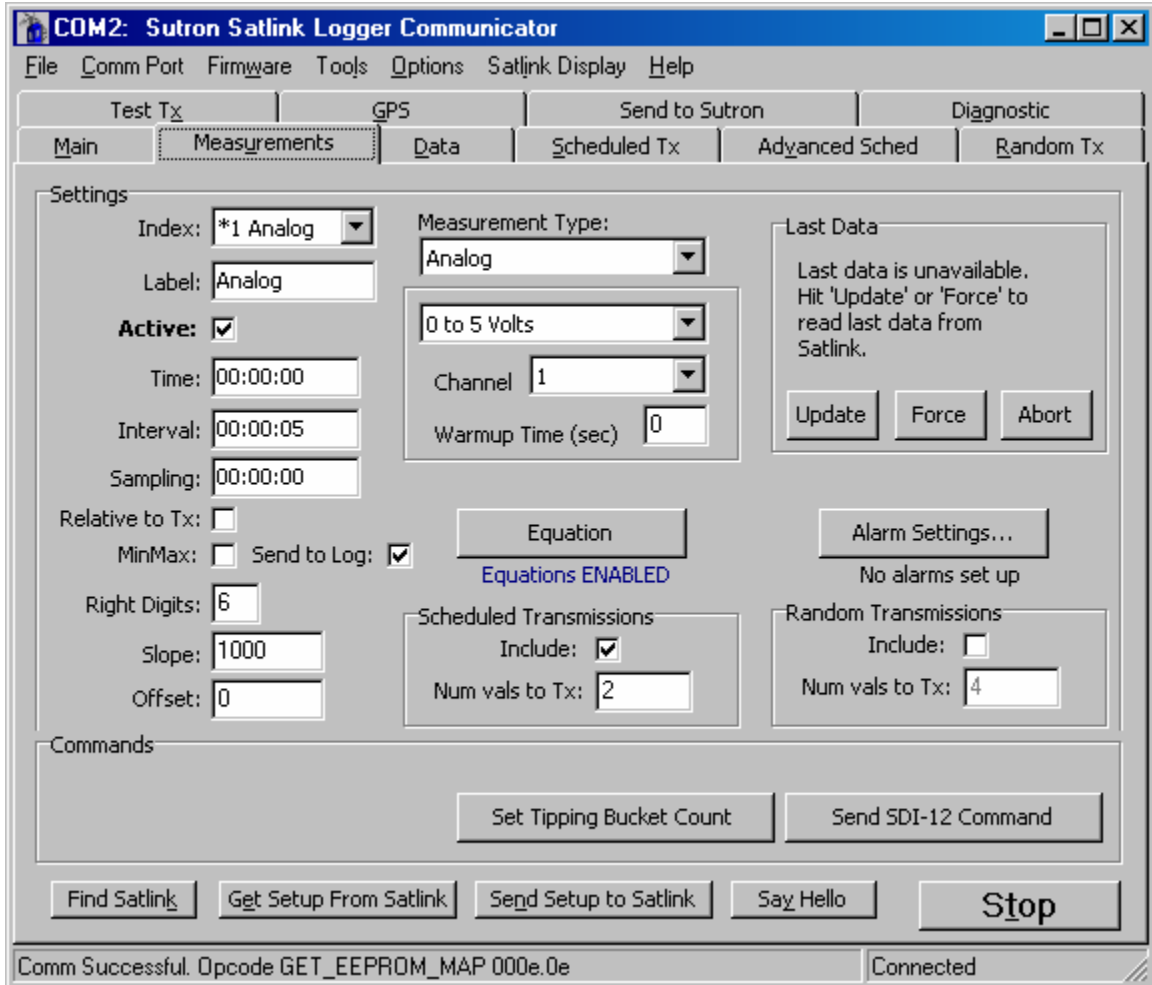
General Measurement Settings

The user can define up to 10 measurements. The "Settings" portion of the Measurements tab on the Communicator, and the "Measurements (1)" page of SatComm, are used to do this. The "Index" box selects which of the ten measurement's settings to display. These boxes also contain the label of the measurement, and shows whether the measurement is active, indicated by an asterisk prior to the index number. Measurements are made only when the unit is running, i.e., only when the unit has been started.

Label

"Label" is an ASCII string used to name a measurement. This string can be up to 7 characters in length and up to 6 characters if measurement is used for MIN/MAX operations. The label is stored with the data in the log so that data can be correlated with the measurement from which it came.   This label is also used in a SHEF format transmission to label the data. Refer to http://noaasis.noaa.gov/DCS/htmfiles/schefcodes.html for a list of the SHEF codes published by NESDIS. While you are not required to use the SHEF codes to label your data, using the codes may simplify the overall handling of the data.

For ARGOS transmissions, this field has special meaning. Please refer to the Appendix L: ARGOS on page 141 for details.

Active

When the "Active" box is checked, the measurement will be processed when the unit is running. **When "Active" is not checked, no measurement will be made.** In addition, the user will not be allowed to change measurement properties until the "Active" box is checked.

Time and Interval

The "Time" and "Interval" fields are used to define when and how often the measurement is to occur. Each is expressed in a string having the format HH:MM:SS (hours, minutes, seconds). "Time" indicates the time relative to the 24-hour clock when the measurement should begin. "Interval" specifies how often the measurement is to occur. For example, if "Time" is set to 00:05:00 and "Interval" is set to 00:10:00, then the measurement will occur every 10 minutes relative to a starting time of 00:05:00 (i.e., 00:05:00, 00:15:00, 00:25:00, … 12:55:00).

Minimum interval. How fast Satlink can sample depends on the measurement types. SDI-12 can be sampled every two seconds or as fast as the sensor will allow, whichever is longer. Analog measurements take either one or four seconds, depending on the measurement type. Tipping bucket and manual entry measurements can be done once a second.

If Satlink is programmed to have a shorter interval than what is specified above, it may miss measurements and log errors. In addition, Satlink can never sample any faster than the sensor's response time.

A note on the measurement interval: if there is more than one measurement enabled, the sampling times are cumulative. For example, if one 0 to 5 Volts measurement and one SDI-12 measurement are setup, each of those measurements can only be made once every three seconds (one second for the analog and two seconds for the SDI). This assumes the SDI-12 sensor will have data in two seconds or less.

Sampling/Averaging

The "Sampling" field is used only if the user is interested in averaging measurements. If "Sampling" is set to a non-zero value, sampling is considered enabled. In that case, Satlink will make a sensor reading every "Sampling" time period. Once every "Interval", Satlink will add up all the sensor readings and divide them by number of readings. This result will be the measurement that will be logged and transmitted.

Satlink can only sample so fast; see the previous section describing the Measurement Interval for Satlink sampling limits.

A measurement interval of 00:01:00 (one minute), and a sampling interval of 00:10:00 (10 seconds), Satlink will make six readings at the following times:

<div align="center">

12: 00: 00
12: 00: 10
12: 00: 20
12: 00: 30
12: 00: 40
12: 00: 50

</div>

Relative to Transmission

When "Relative to Tx" ("Rel Tx" in SatComm) is checked, the measurements "Time" is taken to mean "prior to the next transmission". For example, if measurement time equals 00:05:00, and measurement interval equals 00:15:00, and scheduled transmissions are set to go at the top of the hour, then the measurement will occur every fifteen minutes relative to a starting time of 00:55:00 (i.e., 00:10:00, 00:25:00, 00:40:00, 00:55:00, etc.). Note that the measurement will still occur at its interval.

Note that in order to transmit the most recent data, measurements need to be set up to occur a few minutes before transmissions.

MinMax

MinMax stands for minimum and maximum. The purpose of this setting is to allow Satlink to measure the minimum (the smallest) and maximum (the largest) sensor reading. This feature was introduced with Satlink version 6.11.

When MinMax is enabled, every sampling interval, Satlink will make the measurement. The reading will be compared to the current minimum and maximum. If the reading is less than the current minimum (or greater than the current maximum), it will be remembered as the current minimum (or maximum). In addition, the time of the reading will also be remembered.

Once the measurement interval is complete, Satlink will log the minimum, time of minimum, maximum and time of maximum. In addition, these four readings will be remembered for use in transmissions.

In order to function properly, the sampling interval needs to be non-zero and less than the measurement interval.

Note that times of minimum and maximum are **rounded up to the nearest minute**.

With a measurement interval of 01:00:00 (one hour), and a sampling interval of 00:20:00 (20 minutes), Satlink will make three readings and record the minimum and the maximum.

Time	Reading	Remark
12:00:00	10.0	Minimum
12:20:00	12.5	
12:40:00	15.1	Maximum

When viewing MinMax readings in the "Data" tab, no more than eight measurements will ever be shown. Those eight measurements will be four pairs of one minimum and maximum.

Also note that the label length for the measurement is reduced from a maximum of 7, to a maximum of 6. This is for Satlink to maintain a record in the last character, that the measurement is a MIN/MAX reading.

Encoding MinMax for transmissions:

When **SHEF** or **SHEFFIX** is selected as the transmission format, the minimum and maximum are formatted in separate records. For example, if setup to transmit two values, the sensor labeled HG would be formatted like so

:HG 45 #180 5.810 5.943:HG 160 #180 5.667 5.669

:HG is the name of the sensor. 45 means the last maximum was measured 45 minutes before transmission start. 180 means the measurement interval is 03:00:00 (three hours expressed as 180 minutes). 5.810 is last maximum reading for the sensor and 5.943 is a previous maximum (whose exact time cannot be determined but which was made during the previous interval). Similarly, 160 means the minimum was measured 160 minutes ago, 180 indicates the measurement interval in minutes, 5.667 is the last minimum sensor reading, and 5.669 is the previous minimum reading.

Pseudobinary formatting will have four data transmitted for each number of values user chose to transmit. The four data are minimum, time of minimum in minutes since day start, maximum, and time of maximum. Each one will be a standard three byte pseudobinary value. When encoding time of minimum and time of maximum for pseudobinary transmissions, the number of right digits is considered zero. Neither time of minimum nor time of maximum has a fractional part, so no data is lost. This is done to ensure that the value does not exceed the limit imposed by pseudobinary and ASCII Sensor transmission formats.

For some transmission formats, the time of minimum and the time of maximum are expressed in **minutes since start of day**. For example, if the maximum temperature was recorded at 08:25:00, the time would be expressed as 505. (Times are rounded up to the nearest minute: 08:25:05 is 506).

For **ASCII Sensor** mode four values are transmitted: minimum, time of minimum in minutes since day start, maximum, and time of maximum. When encoding time of minimum and time of maximum for ASCII Sensor mode, the values will NOT be multiplied by 100. This will allow time values of greater than 99 to be properly transmitted.

ASCII Column mode is inappropriate for MinMax. MinMax will have four values (minimum, time of minimum in minutes since day start, maximum, time of maximum) in its column. Unless all the other measurements have four values transmitted, the table will be scrambled. Even if there are four values setup for every measurement, the rows will not have measurements made at the same time.

How to get a measurement and its MinMax transmitted
If one were to want to measure and transmit a sensor and its MinMax, one would have to setup two measurements.

Measurement 1 is setup with the label Press. It is setup with an interval of 00:10:00. Minmax is not selected. It is included in scheduled transmissions with 6 values marked for transmission.

Measurement 2 is labeled PresMM. It is setup with an interval of 01:00:00 and a sampling of 00:01:00. MinMax is selected. It is selected for scheduled transmissions (which automatically selects 4 values for transmission).

Both measurements are setup as SDI-12, address 1, command M!, and parameter 1. Both are setup to be logged.

- Every minute, the pressure sensor is read. The value is considered for minimum and maximum.
- Every 10 minutes, the reading is logged and marked for transmission.
- At 59 minutes past the hour, the last sample is collected for MinMax. Of the 60 readings made during the hour, the minimum and maximum are selected and marked for transmission.

Transmission data (transmitted at 00:41:01) for our example:
:Press 1 #10 1007.57 1007.74 1007.88 1008.16 1008.42 1008.39 :PresMM 67 #60 1008.53 :PresMM 58 #60 1007.33

First we see Press, 1 indicating the most recent reading was made one minute prior to transmission, 10 indicating the measurement interval, followed by six most recent readings. Then comes the maximum reading PressMM, recorded 67 minutes ago on a 60 minute interval with a value of 1008.53. Lastly is the minimum (also labeled PressMM), recorded 58 minutes ago, on a 60 minute interval with a value of 1007.33.

Send to Log

"Send to Log" ("Log" in SatComm) is used to indicate whether measurement data should be logged. When checked, measurement data is logged. Note that "Slope" and "Offset" are applied before logging the data.

Right Digits

The value specified in "Right Digits" determines the precision to be used when displaying and transmitting measurement values. This value is an integer ranging from 0 to 7. Note that logged values are unaffected by this setting.

Slope and Offset

The values of "Slope" and "Offset" are applied to raw measurement data (e.g., data received from an SDI-12 sensor, tipping bucket, or manual entry). The raw data is multiplied by Slope and then has Offset added to it, as in: measurement = (raw * slope) + offset. Note that "Slope" and "Offset" are applied before logging the data. **Note that if "Equations" are enabled, "Slope" and "Offset" are still applied to the data after "Equation" processing.**

Satlink Logger records measurements as IEEE32 floating point numbers.

Measurement Type Settings

Tipping Bucket Accumulation

When the measurement type is set to "Tipping Bucket Accumulation", the measurement's raw data (pre slope and offset) is obtained by reading the number of counts from the attached tipping bucket. Physically, a tipping bucket is to be connected to the sensor port on the front of Satlink, using pin 9 (high) and pin 5 (low). This connector may be labeled "I2C" on older Satlinks. This is the total accumulation of counts since recording start, adjusted for the last calibration, if a calibration was performed.

SDI-12

When the measurement type is set to "SDI-12", data is obtained by sending a command to the SDI-12 sensor. The sensor will reply with the measured data. The command is set by the user through the "SDI-12 Address" and "SDI-12 Cmd" fields. For example, if the address is set to "0" and the command is set to "M!", "0M!" will be sent to the sensor.

Some sensors will respond with multiple data values. The "SDI-12 Param" designates which of these data values the user is interested in. For more information on SDI-12 sensors, refer to Appendix D.

The common setup for SDI-12 sensors is to specify the "SDI-12 Address" as "0", "SDI-12 Cmd" as "M!" and the "SDI-12 Param" as "1". This commands SDI-12 device at address 0 to make a measurement and to take the first value returned. Newer SDI-12 devices support the following additional commands:

MC	Measure and include CRC in reply
C	Measure concurrent
CC	Measure concurrent and include CRC in reply
R	Read real-time

Some SDI-12 devices can return more than one sensor reading, such as a water quality probe that returns Dissolved Oxygen, Conductivity, Temperature etc. Some of these devices will return more than one reading when issued a single measurement command and others require that multiple measurement commands be given.

In the case of the devices that return more than one reading to a single measure command, the "SDI-12 Param" specifies which of the sensor readings returned by the SDI-12 device to use. Setting the parameter to 1 tells Satlink Logger to use the first value returned from the device; setting parameter to 3 tells Satlink Logger to use the third value returned from the device. If more than one parameter needs to be measured, a different measurement needs to be set up for each parameter. These measurements should have identical setups, except for the "SDI-12 Param". Be sure to keep the measurement time and interval the same for these measurements. If you vary the time and interval, Satlink Logger will end up taking multiple measurements rather than retrieving multiple values from the same measurement.

In the case of devices which require multiple commands to be issued (e.g. 0M1! retrieves pressure, 0M2! retrieves temperature) multiple measurements need to be set up. It does not matter if these measurements are scheduled for the same time, as Satlink Logger will have to issue multiple commands to the sensors.

When multiple measurements of type SDI-12 are scheduled to go at the same time, Satlink Logger orders the measurement commands so that concurrent measurements are commanded first. Non-concurrent measurements occur while waiting for concurrent results. Also, Satlink Logger is able to recognize when two different measurement schedules rely on data from a single measurement command (e.g., measurement 1 commands "0M!" and expects parameter 1 while measurement 2 commands the same and expects parameter 2, both scheduled at the same time). In such cases, Satlink Logger outputs the measurement command only once.

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Manual Entry

When the measurement type is set to "Manual Entry", the measurement's raw data is obtained from the manual entry associated with the measurement schedule. This value is displayed and may be edited in the "Manual Entry" field below the type settings. This value may also be set by a device communicating with Satlink Logger over the RS-232 interface using the appropriate interface command. In this way, Satlink Logger allows attached devices to essentially pass in raw measurement data. Manual entries can be changed even when the unit is running by pressing the "Set" button.

8400

Measurement type of 8400 indicates that Satlink is to collect data from Sutron's 8400 DDR. Use the "8400 Sensor Name" field to tell Satlink which of 8400's data to collect.

The 8400 is a data logger capable of measuring multiple sensors. Each of these sensors is identified by its name. The most common sensor names are STAGE and PRECIP. Make sure to tell Satlink the name of the sensor exactly as it appears in the 8400. Otherwise, Satlink will not be able to make the measurement. To ensure proper setup, use the "Force" button on the Measurement Tab – it causes Satlink to fetch the data from the 8400 and tell you whether it was successful.

When Satlink is set to collect data from the 8400 it will retrieve the most recent data value of the named sensor. Note that the 8400 collects data on its own schedule (independent of Satlink). The user needs to ensure that the 8400 is set to collect data at appropriate times. This generally means that the 8400 needs to be setup to measure a minute before Satlink collects the data from it.

Satlink sets the 8400's time periodically. Satlink Logger is compatible with 8400 versions 1.2, 1.8, and 2.5.

Battery Voltage

"Battery Voltage" is a measurement type that will have Satlink measuring the voltage given to it by its power supply. In addition to blinking the red LED twice when making the measurement, Satlink will also blink the green LED once when measuring battery voltage.

When scheduling the battery voltage measurement, make sure that it does not happen during the transmission. If it does, you will notice that the battery voltage is somewhat lower than usual due to the power draw of the transmitter.

Satlink measures its voltage under load during a transmission. The voltage under load is different than the measurement of "Battery Voltage". The voltage under load can be appended to the messages Satlink transmits by selecting "Append Quality" from the Scheduled tab. Each message will carry the reading from the *previous* transmission. The battery voltage under load should be somewhat (0.5V) lower than regular voltage with a good battery. The measurement is made during the transmission carrier.

Analog

Satlink 2 has four analog channels which can be configured for measurements. An analog measurement usually results in a voltage reading which needs to be processed by an equation to get meaningful results. Please refer to the sensor documentation in order to properly setup the analog measurement. An analog setup completely depends on the sensor being measured.

Four channels allow up to four different sensors to be connected to Satlink. Unlike SDI-12, different sensors may not share channels. However, the grounds and voltages may be shared.

Satlink 2 allows for different types of analog measurements:
- 0 to 5 Volts
- Ratimetric

- 78 Millivolts differential
- 625 Millivolts differential
- Bridge

0 to 5 Volts, which is a single ended measurement that is most appropriate if the user wishes to read a voltage that is between 0 and 5 volts. Physically, the sensor is connected to analog ground and one of the four analog input channels. These measurements are made quickly and can be sampled as fast as **once per second**. This measurement will have an input impedance around 5 Meg ohms which means that the source impedance of the device being connected needs to be less than 5 K ohms if the loading error is to remain below 0.1%. For voltage output devices this should not be an issue since they typically have an output impedance less than 100 ohms. For high source impedance inputs like 1potentiometers, thermistors, and other resistive dividers, use the ratiometric measurement type.

The second type of measurement (**ratiometric**) would have the user connecting his sensor to ground, to reference voltage, and to one of the four channels.   The result would be expressed as a floating point number between zero and one, representing the ratio of the input voltage to the reference voltage. As such, it is a relative number, a unit less reading. This type of measurement is sometimes referred to as a **half bridge** measurement. In terms of ATD settings, this measurement would be buffered (meaning that it has an input impedance in the gigaohm range and therefore can measure high source impedance inputs without loading them). Being buffered, the best accuracy is obtained between 0.05 V and 3.5V (readings of 0.02 to 1.4).   Ratiometric measurements can be sampled as fast as **once per second**. When converting these readings to sensor units (like degrees C) they may need to be multiplied by the expected reference voltage. For example, if a temperature sensors like the 5600-0010 or 5600-0020 that have instructions for connection to a 5V excitation and list the slope as 35.76 for converting to degrees C were used, you would multiply the readings by 5 (the expected excitation voltage) in addition to the provided 35.76 slope. Therefore you would set the slope to 35.76 * 5 or 178.8. You would also use the provided offset of -72.8 (it does not get multiplied).

The third and fourth measurements (**78mV and 625mV differential**) are used for devices which output a voltage that is less than 78 and 625 millivolts respectively. The user would connect his sensor to the two channels specified in the channel selection (either 1 and 2, 3 and reference voltage, or 3 and 4). Both 78mV and 625mV measurements are unbuffered. The 78mV will have in input impedance of about 100 kohms and the 625 millivolt scale will have in input impedance of about 1 megohm.   Both of these would allow negative differential voltage measurements (measuring a range of -78mV to +78mV or -625mV to +625mV). Note: The voltage is negative with respect to the other input of the differential pair. Both voltages of the differential pair need to be within 0-5V of analog ground. The differential readings are made at a slow sampling rate can be collected as quickly as **once every four seconds**. When using a floating sensor that generates its own voltage, like a solar radiation sensor, the generated voltage needs to be referenced to the Satlink so it will not float outside of the 0-5V common mode range. This can be accomplished by connecting the negative input to Vref (or analog ground) in addition to the negative differential channel. For most applications, it is recommended that the 625mV scale be chosen instead of the 78mV scale because it has a higher input impedance and because it has much better absolute accuracy. If your primary objective is to detect small changes in a small signal, then the 78 mV scale has a little better noise performance. The peak to peak noise level of the 78 mV scale is about 3 micro-volts and about 10 micro-volts on the 625 mV scale. For high source impedance low level differential inputs like mV output pressure sensors and strain gauges, use the bridge measurement type.

Bridge is another type of analog measurement. It is for measuring resistive bridge type sensors which are ratiometric sensors with a differential output. The user would connect the excitation or supply positive to vref, negative to analog ground, and then connect the sensor output to the two channels specified in the channel selection (either 1 and 2 or 3 and 4). The result of a bridge measurement is number representing the ratio of the input voltage to the reference voltage. As such, it is a unit less number, and ranges from -0.25 to +0.25. Buffering is enabled which means that the input impedance is in the gigaohm range. A slow sampling rate is used, allowing for a reading **once every four seconds**. Bridge type sensors state their output in a couple of different ways. For example, a 5 psi sensor may state that it has a 50 mV output with a 10 Volt excitation. For this example, if we wanted to log feet of water and use the USGS standard conversion of 2.3073 feet of water per psi, then we

would compute the slope as follows: 10 Volts * (5 psi / 0.05 volts) * (2.3073 ft / psi) = 2307.3   There are other sensors that may specify their output in terms of sensitivity. For example the sensitivity of the pressure sensor could be listed as 0.43 mV/V/ft H2O. The sensitivity is already stated as a ratio. Since it is mV to Volts, it is the Satlink reading times 1000. The sensitivity in V/V/ft H2O would be 0.00043 and to have the Satlink log feet of water, we would set the units slope to 1/ sensitivity or 2325.8

A note on sampling speed: if there is more than one analog measurement enabled, the sampling times are cumulative. For example, if two different 0 to 5 Volts measurements are setup, each of those measurements can only be made once every two seconds. If only one 0 to 5 Volts measurement is setup, than it can be made once a second.

The control labeled "**Warmup time**" would specify for how many seconds both the switched 12 Volts and reference voltage would be turned on prior to making the measurement. A warmup time of 0 would indicate that switched 12 Volts should not be turned on at all. Reference voltage will always be on for about a second prior to measurement (even if the user selects 0 as the warmup time).

Satlink Temperature

"Satlink Temperature" uses a thermistor inside Satlink to measure temperature.

Tipping Bucket Rate

When the measurement type is set to "Tipping Bucket Rate", the measurement's raw data (pre slope and offset) is obtained by reading the number of counts from the attached tipping bucket and subtracting out the last measured count
Physically, a tipping bucket is to be connected to the sensor port on the front of Satlink, using pin 9 (high) and pin 5 (low). This connector may be labeled "I2C" on older Satlinks. This is the number of counts since the last measurement.

Equation Processing

Satlink allows the data collected from measurements to be processed by an equation. If the reading provided by the sensor needs more than just an offset and a slope applied, equations provide that functionality.
By pressing the "Equation" button on the "Measurements" Tab, the following window appears:
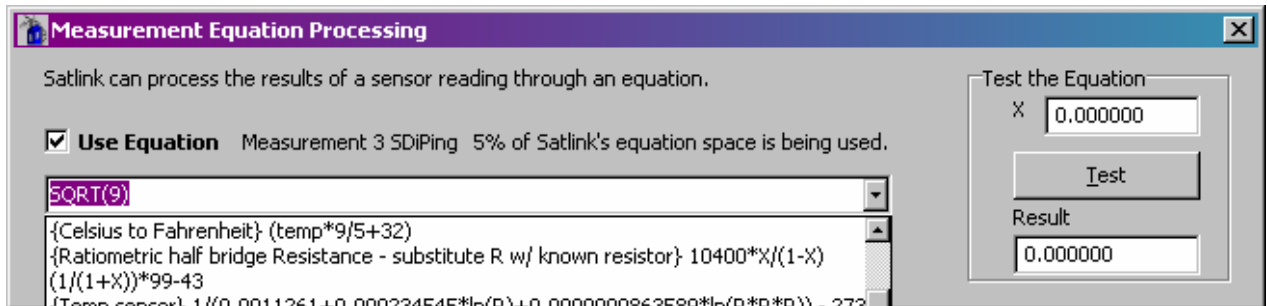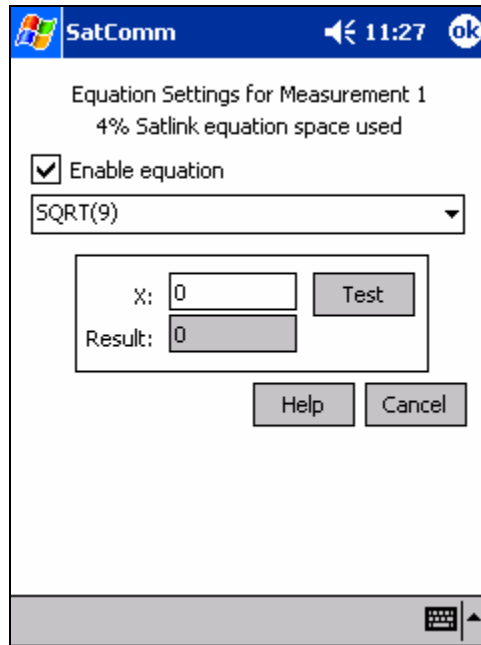
Equation Syntax

The equation is expressed in terms of "X" which will be applied to incoming sensor data.

You may also reference each measurement by its label which is defined on the Measurement tab. The expression is not case sensitive.

The following functions are available:
SIN, COS, TAN, ARCTAN, eg COS(90) = 0

SQRT is square root, eg SQRT(9) = 3
To raise a number to a power, multiply it by itself. So, for example, to find x squared, input x*x.
EXP, if EXP(x) = y, then LN(y) = x, eg EXP(1) = 2.718282
LN, natural log, eg LN(2.718282) = 1
LOG, 10 based log, eg LOG(10) = 1

INT returns the integral portion of a real number
INT(11.456) = 11.000 INT(-1.345) = -1.000
FRACT returns the fractional portion of a real number.
FRACT(11.456) = 0.456 FRACT(-1.345) = -0.345
ABS returns the absolute value of a real number.
ABS(11.456) = 11.456 ABS(-1.345) = 1.345

Comparison can be performed using <, >, <=, >=, !=, and =. The result of a comparison is 1 for true or 0 for false.

The following bitwise boolean operators are supported: AND, OR, XOR, SHL, and SHR. The last two are shift-left and shift-right. For instance (X SHL 4) would shift X left by 4 bits. AND & OR can also be used in logical expressions. For instance
(X>100) OR (X<50)
would result in 1 if X is above 100 or below 50; otherwise it would result in 0.

The NOT operator is logical not bitwise. This means that NOT 0 is 1 and NOT 1 is 0. Also, the NOT of any non-zero number is 0.
eg. (X AND 128) != 0results in a 1 if bit 7 in X is set or 0 if bit 7 is clear. The bit mask 128 is 2^7. This assumes bit 0 is the least significant bit. In general, the bit mask for any bit N is 2^N.

Equations can also contain references to other sensors:eg. (X + AirTemp)/2
would add X to the AirTemp value and divide by 2.
Comments can be contained within braces { }
{convert from degrees Celsius to degrees Fahrenheit} X*9/5+32

Other examples:

SIN(X)+COS(X)+X^3+LOG(X)

(X>1000)*1000 + (X<=1000)*X {would limit the value so that it could never be greater than 1000}

Troubleshooting:

If Satlink claims that the equation is invalid, and the equation contains references to other measurements, try sending the setup to Satlink and then retry testing the equation.

The only true test of equation processing is to hit Force Measurement after the equation has been set.

Satlink has a limited amount of memory dedicated to storing the equations. If a message appears saying that the equation could not be set, and Satlink is nearing the memory limit, then the most likely cause of the problem is lack of memory space.

If both Equations and Slope and Offset are used, Slope and Offset are applied after the equation is processed.

Transmissions and Measurements

When the "Include" checkbox in "Scheduled Transmissions" is checked, the measurement's data will be included in scheduled transmissions. The value in "Num vals to Tx" then determines how many values to include in the transmission. Likewise, when the "Include" check box in "Random Transmissions" is checked, the measurement's data will be included in random transmissions.

Measurement Alarm Settings

The "Alarm Settings" button opens a dialog that allows the user to configure the conditions in which a random transmission should be signaled. Beneath the "Alarm Settings" button is text describing whether any alarms are set up.

An image of Communicator's alarm settings dialog appears below:
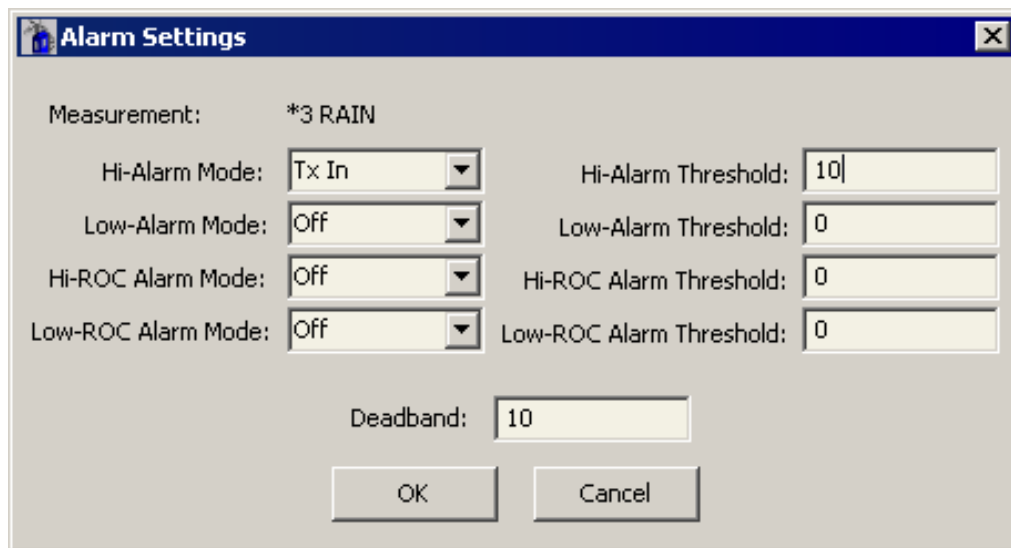
The following is the SatComm alarm settings dialog:

The "Measurement Index" field in Communicator, and the header test in SatComm, display the currently selected index that the alarm settings refer to.

There are four different kinds of alarms. A measurement is in alarm when its mode is set to something other than "Off" and its data meets the conditions for alarm (see below). The alarm mode determines when random burst transmissions occur. When the mode is set to "TxIn", random burst transmissions are signaled when the measurement goes into alarm. When the mode is set to "TxOut", random burst transmissions are signaled when the measurement goes out of alarm. When the mode is set to "TxBoth", random burst transmissions are signaled when the measurement goes either into, or out of, alarm.

A measurement goes into "Hi-Alarm" when the "Hi-Alarm Mode" is set to something other than "Off" and the measurement's data goes above "Hi-Alarm Threshold" plus "Deadband". A measurement goes out of "Hi-Alarm" when the "Hi-Alarm Mode" is set to something other than "Off" and the measurement's data goes below "Hi-Alarm Threshold" minus "Deadband".

For example, suppose a water level sensor is connected to Satlink Logger, and the Hi-Alarm Threshold is set to 10, with the Deadband set at 2. If the water level exceeds 12 (10 + 2) and the High Alarm Mode is set to either "TxIn" or "TxBoth", then Satlink Logger will send a burst of random transmissions, as defined in the Random Tx section. After finishing its burst of random transmissions, or if the High Alarm Mode were set to "TxOut", Satlink Logger will send random transmissions at a rate derived from the Random Alarm Interval. When the water level falls below 8 (10 – 2), Satlink Logger will send another burst of random transmissions if the mode is set to either "TxOut" or TxBoth". After this, Satlink Logger will resume its random transmissions at the Random Normal Interval.

The "Low Alarm" is similar, but now the measurement goes in to "Low-Alarm" when the measurement's data goes below the "Low-Alarm Threshold" minus "Deadband" and the "Low-Alarm Mode" is set to something other than "Off". This same measurement goes out of "Low-Alarm" when the measurement's data goes above "Low-Alarm Threshold" plus "Deadband" and the "Low-Alarm Mode" is set to something other than "Off".

Another type of alarm is the Rate of Change alarms. The "Hi-ROC Alarm" is triggered for a measurement when the "Hi-ROC Alarm Mode" is set to something other than "Off" and the measurement's data goes above "Hi-ROC Alarm Threshold" plus "Deadband". A measurement goes out of "Hi-ROC Alarm" when the "Hi-ROC Alarm Mode" is set to something other than "Off" and the measurement's data goes below "Hi-ROC Alarm Threshold" minus "Deadband".

Using the previous example, now suppose the user wants to measure how fast the body of water is swelling and send a transmission if the rate of change is above a certain level. With hourly measurements a good "Hi-ROC Alarm Threshold" might be 1.25 with a Deadband of 0.75. The burst, alarm, and normal random transmissions work the same as in the previous example, but this time the measurement enters alarm mode when the data has changed by greater than 2 (1.25 + 0.75), for example from 6 in one measurement to above 8 in the next measurement. It will exit alarm mode when the rate of change falls below 0.5 (1.25 – 0.75), or, for example, when one measurement is 8 and the next less than 8.5.

A measurement goes in to "Low-ROC Alarm" when the "Low-ROC Alarm Mode" is set to something other than "Off" and the measurement's data goes below "Low-ROC Alarm Threshold" minus "Deadband". A measurement goes out of "Low-ROC Alarm" when the "Low-ROC Alarm Mode" is set to something other than "Off" and the measurement's data goes above "Low-ROC Alarm Threshold" plus "Deadband".

Because ROC Alarms are timing sensitive, it should be mentioned that measurements are not necessarily made at the exact time they are scheduled, but depend on a variety of factors. The exact time when measurements are made can be viewed on the Diagnostics tab in the debug output window.

Last Data

The "Last Data" group allows the user to view the last measured value and to "force" a measurement. This block contains the Data, Time, and Quality information for the most recent measurement. To update these fields with data from the last scheduled measurement, press the "Update" button.

The user can also request a measurement be made immediately by pressing the "Force" button. Satlink does not have to be stopped for the measurement to be made. If the forced measurement interferes with any scheduled measurements, Satlink will make the scheduled measurements after completing the forced measurement. While the measurement is in progress, the communicator program polls Satlink Logger for the result. A dialog is displayed allowing the user to cancel this polling process. When the measurement completes, the data, time, and quality fields are updated with the new values, unless polling was cancelled. The user can abort a forced measurement that is in progress by pressing the "Abort" button.

Measurement Commands

The "Set Tipping Bucket Count" button opens a dialog that allows the user to specify a new baseline tipping bucket count. The new count replaces the current count and increments with subsequent tips. The unit must be stopped in order to set the tipping bucket count.

When it comes to tipping bucket measurements, there are two numbers to keep in mind. The first one is the raw tip count. This number reflects the physical tips of the tipping bucket. The second number is the measurement of rainfall, which is calculated by applying a slope and an offset to the raw tip count. For example, with one type of tipping bucket, one hundred tips equal one inch of rain. For that tipping bucket the slope would be set to 0.01.

While SatComm's tipping bucket dialog only allows the user to set the raw tip count, Communicator's tipping bucket dialog allows the user to set either the raw tip count, or the scaled rainfall measurement. So, for our example tipping bucket with 100 tips equaling one inch of rain, if the user wanted to set it to show two inches of rain, he could do so by either setting the tip count to 200, or the scaled number to 2.
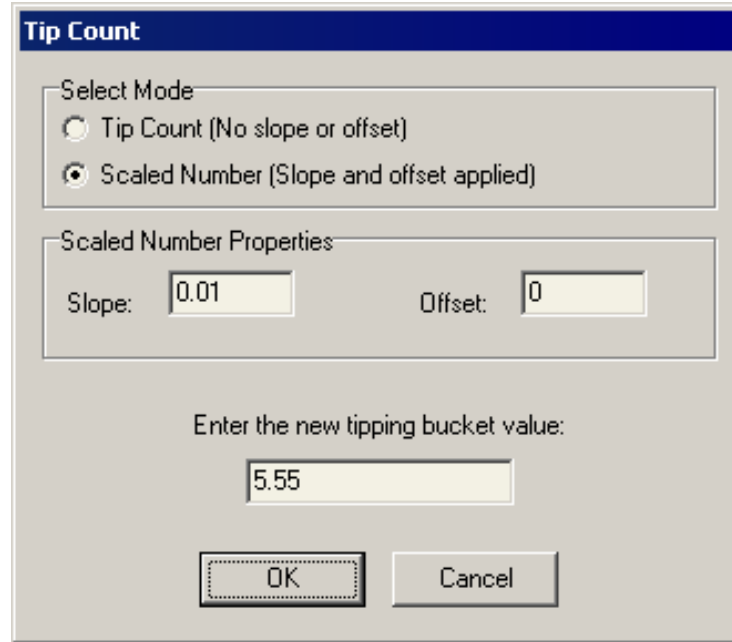
The "Send SDI-12 Command" button offers a transparent mode for the SDI-12 device, which allows the user to input commands directly on the bus. The results of the commands are displayed in the main text window.

The following images show the SDI-12 pages in the Communicator (left) and SatComm (right):
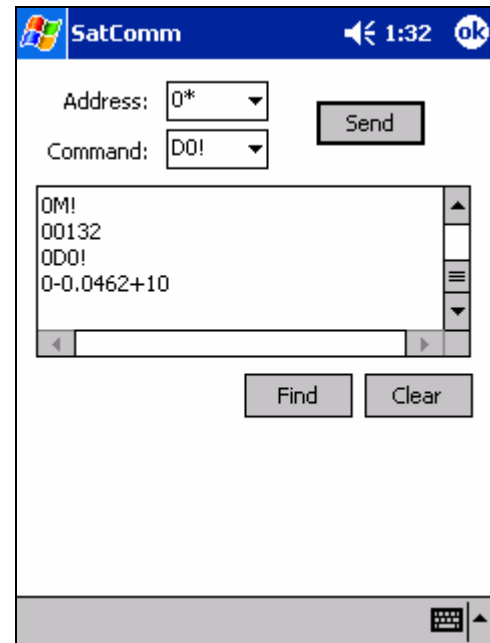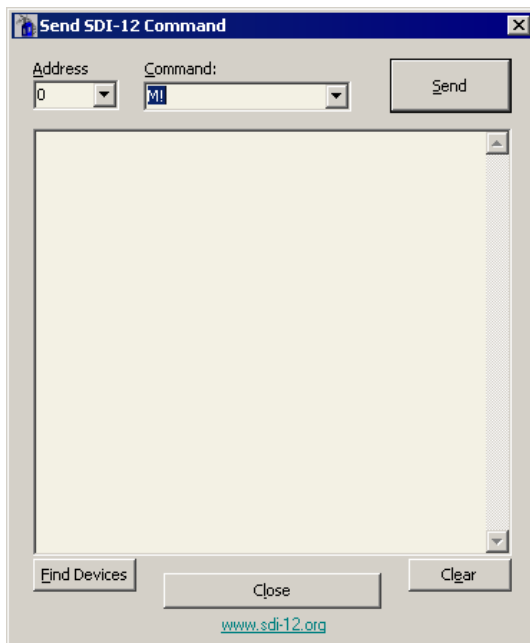
The address and command fields are used to form an SDI-12 command which gets sent once the user hits the "Send" button. Example: if the address field is set to "1" and the command field is set to "D0!", "1D0!" gets sent to the sensor.

If no sensor responds Satlink will report "No response from SDI device.". This usually means that no sensor is at that address, or it could mean that more than one sensors is at that same address. If you get the message "No response from Satlink.", that means that the Communicator program was not able to tell Satlink to talk on the SDI bus.

The address field will place a "*" next to an address on which an SDI-12 sensor was found.

The "Find Devices" button may be used to have all the addresses on the SDI-12 bus searched for sensors. This is convenient if you have more than one sensor connected to the bus, and you would wish to find out what address which one is at. Note that if two or more sensors share the same address, it may not be possible to talk to them. For more information on SDI-12 sensors, refer to Appendix D.
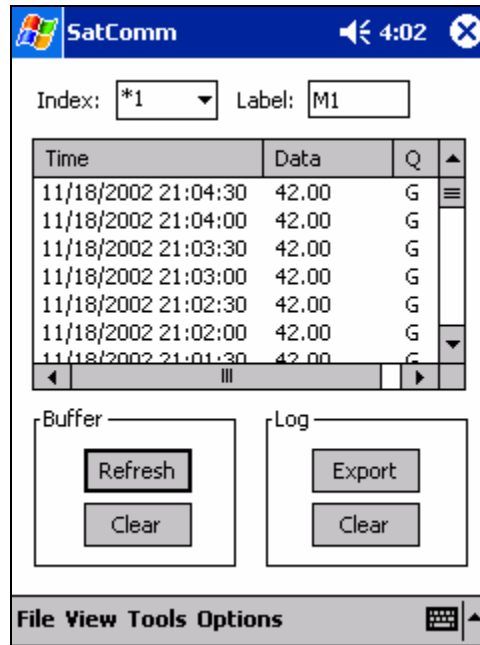
DATA

The Data tab allows the user to view the sensor data. The system keeps 32 readings for each of the 10 measurements. The measurements are displayed according to their schedule.

If, after changing the measurement schedule, data seems to disappear, it is because measurements are displayed according to the new schedule, even though they were made according to the old schedule.

The "Index" box is used to select the desired measurement to view (1 to 10). When an index is selected, the 32 most recent measurements for that index are displayed. The data for this tab comes from special buffers that hold the data for this display and transmissions. Each measurement is labeled with a timestamp of the requested measurement time, and a quality flag for the measurement.

The PC version of the Communicator program allows the user not only to view the 32 most recent readings of a single measurement, but also the last reading of all the active measurements. This selection is accomplished via the radio button labeled "Show Measurements".

Another PC only option is **forcing all measurements at once**. This is a useful feature that can make sure the measurement setup is proper with the click of a single button. When invoked, Satlink will take a reading of each active measurement and display the results in the data window.

If the "Work Connected" option is enabled, the recorded measurements will be automatically updated and displayed when the user first loads the Data tab; however one can also press the "Refresh Data" button to display the most recent data. The "Clear Data" button clears all the last recorded readings without affecting the data log. Since this data is used in transmissions, a transmission after "Clear Data" is pressed will not have data to transmit and will transmit using **missing data** indicators (M or ///).

Logging Functions

Satlink Logger also contains a built-in logging function, which will record the data for measurements with the "Send to Log" box on the Measurements tab checked. The logger will record up to 120,000 measurements including the time and quality stamps. After this, the logger will begin overwriting its oldest data.

In order to access the data recorded in the log one must download the log from Satlink Logger. Pressing the "Export Log" button on the "Data" tab or on the "Tools" menu will bring an export dialog. Communicator's export dialog appears below left, while SatComm's dialog appears below right:
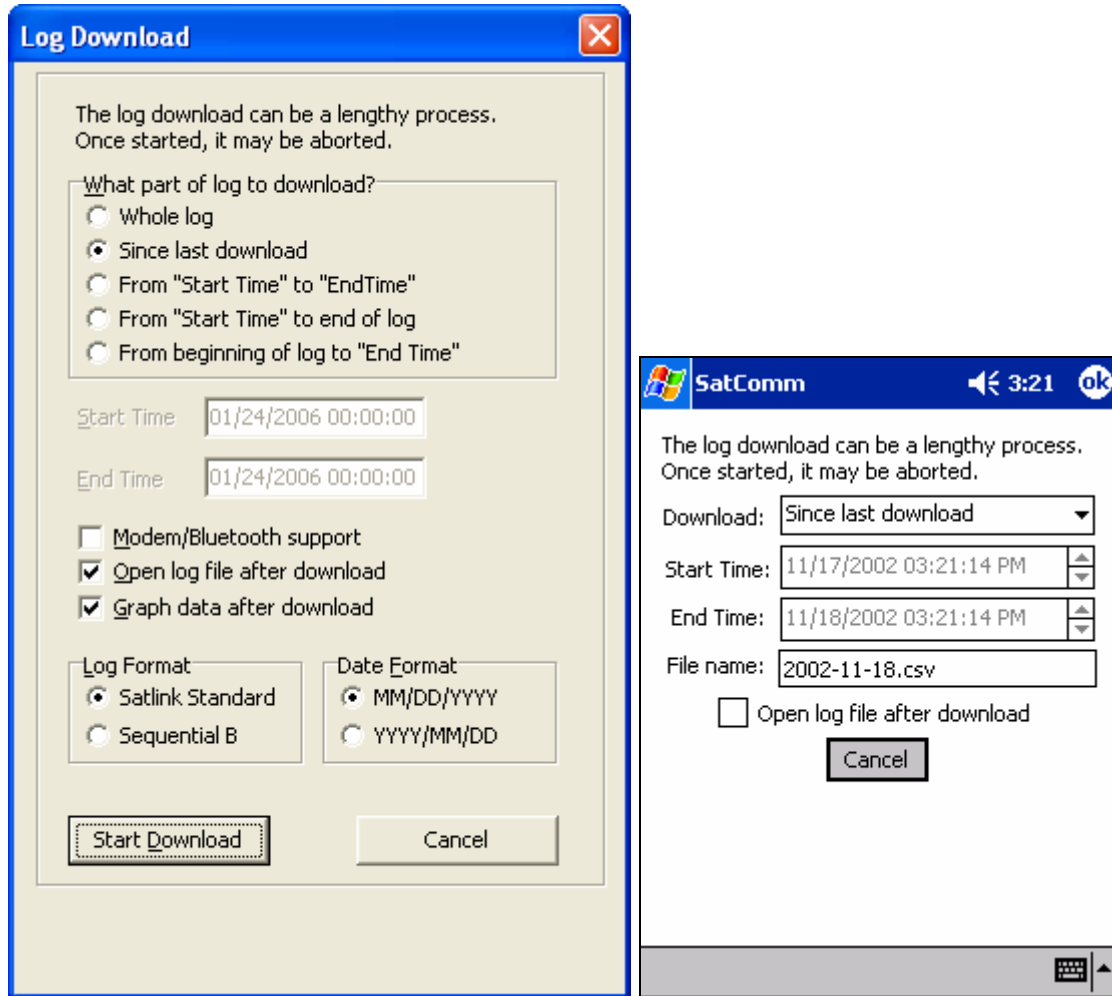
As you can see, Satlink Logger allows for portions of the log to be downloaded by selecting the appropriate button.

One can also reset the data in the log by pressing the "Clear Log" button on the data tab. Note that clearing the log permanently destroys all logged data.

Clicking "Modem/Bluetooth support" will download the log at a slower 9600 baud (as opposed to 115200 baud). Normally, Satlink talks at 9600, but the log download is done at 115200 baud. Switching baud rates will break the connection if the user is connected via modem or Bluetooth unless the "Modem/Bluetooth support" option is selected.

NOTE: 'Open log file after download' on the Communicator will use the default windows program for .csv files (generally Microsoft Excel), whereas SatComm will use Pocket Word. Pocket Word will turn on 'Wrap to window' by default, if you cannot see any data in the Word window, uncheck 'Wrap to window' from the VIEW toolbar.

The log formats determine how the data is formatted in the .csv file. Note that raw data is downloaded from Satlink (to SatlinkTempLog.raw) and then reformatted to a .csv file. Here are examples of the different log formats:

Satlink Standard log format
Analog,10/30/2005,06:36:03,1242.821655,Good
Analog,10/30/2005,06:36:04,1242.815430,Good
Analog,10/30/2005,06:36:05,1242.826660,Good

Analog,10/30/2005,06:36:06,1242.813232,Good
Analog,10/30/2005,06:36:07,1242.824219,Good
Analog,10/30/2005,06:36:08,1242.843994,Good
Analog,10/30/2005,06:36:09,1242.797119,Good
Analog,10/30/2005,06:36:10,1242.821655,Good
Analog,10/30/2005,06:36:11,1242.824219,Good
Analog,10/30/2005,06:36:12,1242.826172,Good
Analog,10/30/2005,06:36:13,1242.821411,Good
Analog,10/30/2005,06:36:14,1242.809937,Good
Analog,10/30/2005,06:36:15,1242.827393,Good
Analog,10/30/2005,06:36:16,1242.830200,Good

Satlink Standard format is comma delimited. It will put the measurement label, the date of the measurement, the time of the measurement, the value of the measurement, and the quality (Good, Bad or Undefined) on each line. Every single measurement has its own line.

Sequential B log format
Satlink Sequential Log Format for Station Alive2 from 01/01/2000 to 01/19/2006

 ,01/01/2000,Alive2,
Analog   ,   1242.837,00:02:45
Analog   ,   1242.802,00:02:50
Analog   ,   1242.809,00:03:10
Analog   ,   1242.803,00:03:15
 ,01/12/2006,Alive2,
Analog   ,   1242.797,02:47:40
Analog   ,   1242.772,02:47:45
Analog   ,   1242.806,02:47:50
Analog   ,   1242.795,02:47:55
Analog   ,   1242.823,02:48:00
Analog   ,   1242.813,02:48:05
Analog   ,   1242.797,02:48:10

The sequential B format is comma delimited and fixed width. It starts with a file header showing the station name and the time span of the data.
Every day of data will start with a date identification which is two spaces followed by the date followed by the station name.
Every measurement reading has its own line. The line starts with the measurement label and is followed by spaces to fill a column 10 bytes wide. The measurement value follows; it is up to 7 digits and it fills a column 12 bytes wide. Measurement time completes the entry.

To get log files from the Pocket PC device onto another computer

Connect the pocket pc device to the computer.
Go to Windows Explorer on the computer.
Go to Mobile Devices
Drag and drop any log files from the mobile device to another directory on the computer. The log files are typically stored in "\My Documents\SatComm".

Graphing
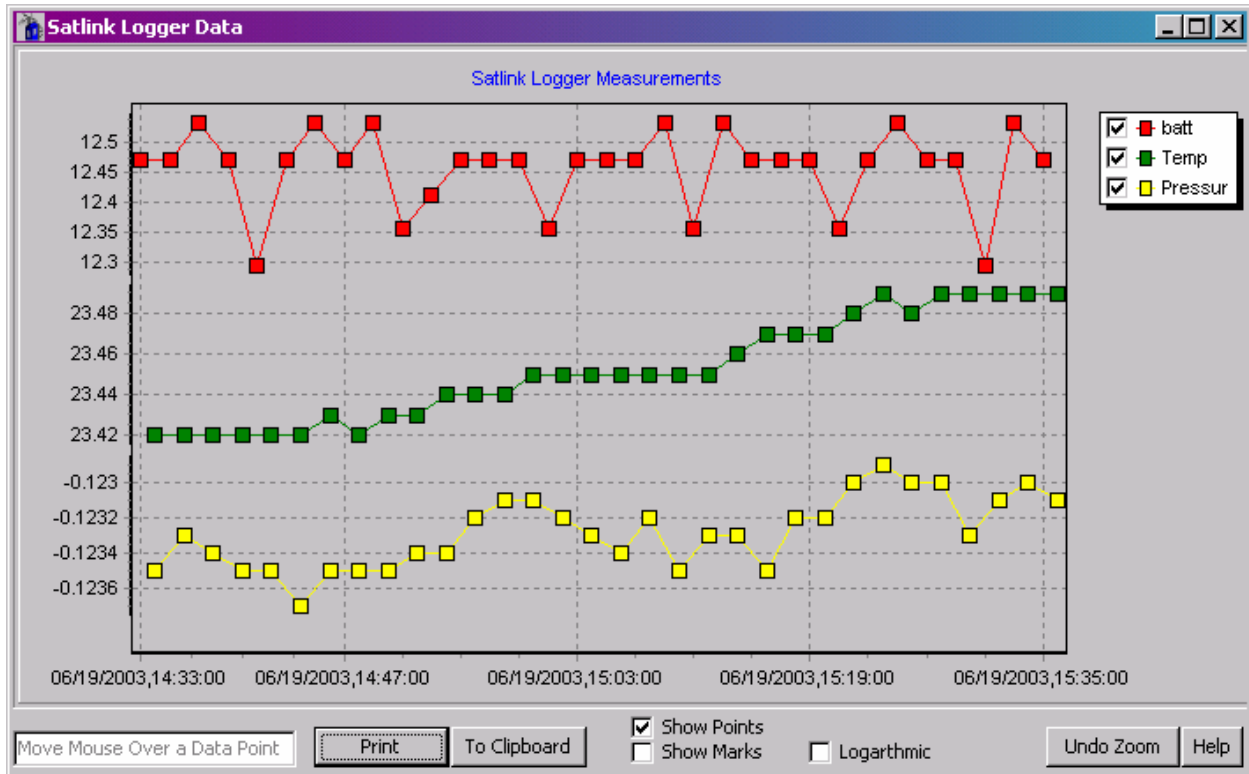
Satlink Communicator now has the option of graphing measured data. Both the recently made 32 readings of each measurement and logged data can be graphed (SatComm graphing is limited to most recent measurements only).

Graphing the recent measurements is accomplished by hitting the graph button which appears on the Quick View status, on the data tab, and in the Tools menu.

Graphing logged data can be invoked from the log download window which appears when the user hits export log from the data tab, and from the tools menu. The user is also given the option of graphing previously downloaded log files that are on his disk.
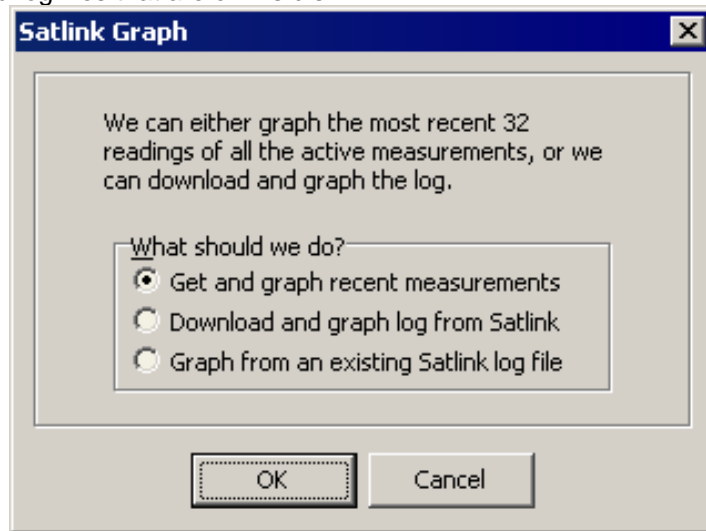
On the graphing window itself, the user is allowed to select which measurements to graph, to do logarithmic scaling, to examine the graph data in detail (by zooming), to print the graph, and copy the graph to the clipboard as a bitmap (which can be pasted into certain programs such as Microsoft word).

Zooming into the data points is accomplished by left clicking and dragging from left to right anywhere in the graph data window. Zooming out is accomplished in a fashion similar to zooming in, except that the dragging is done from right to left. Scrolling is done by right clicking and dragging.

In Communicator, Graphing can be invoked from the Quick View Status, from the Tools menu, from a button on the Data tab, or by selecting the "Graph data after download" checkbox on the log details dialog. In SatComm, graphing is invoked from the Tools menu only.

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SCHEDULED TX

The Scheduled Tx tab shows the detailed setup for scheduled transmissions.
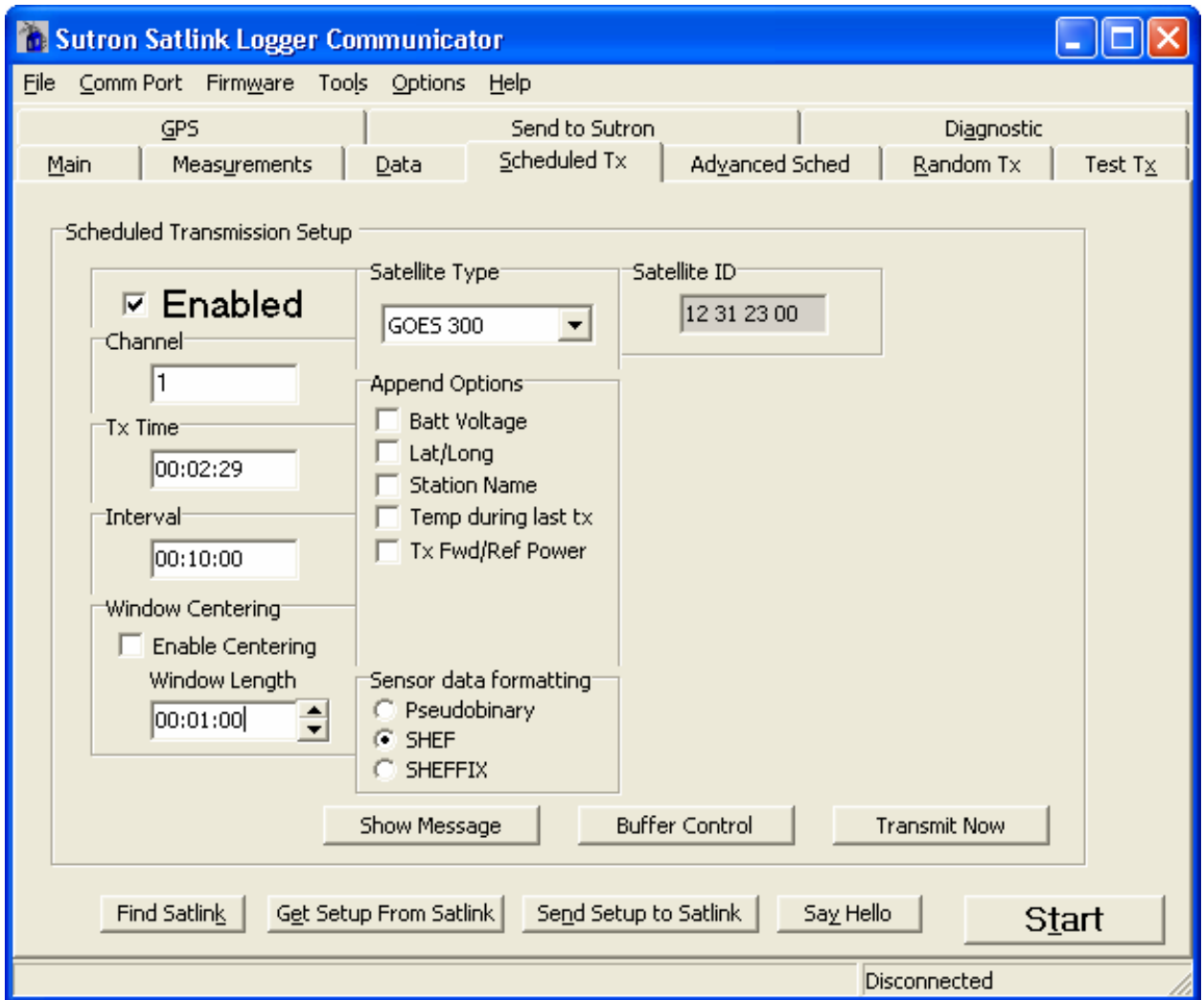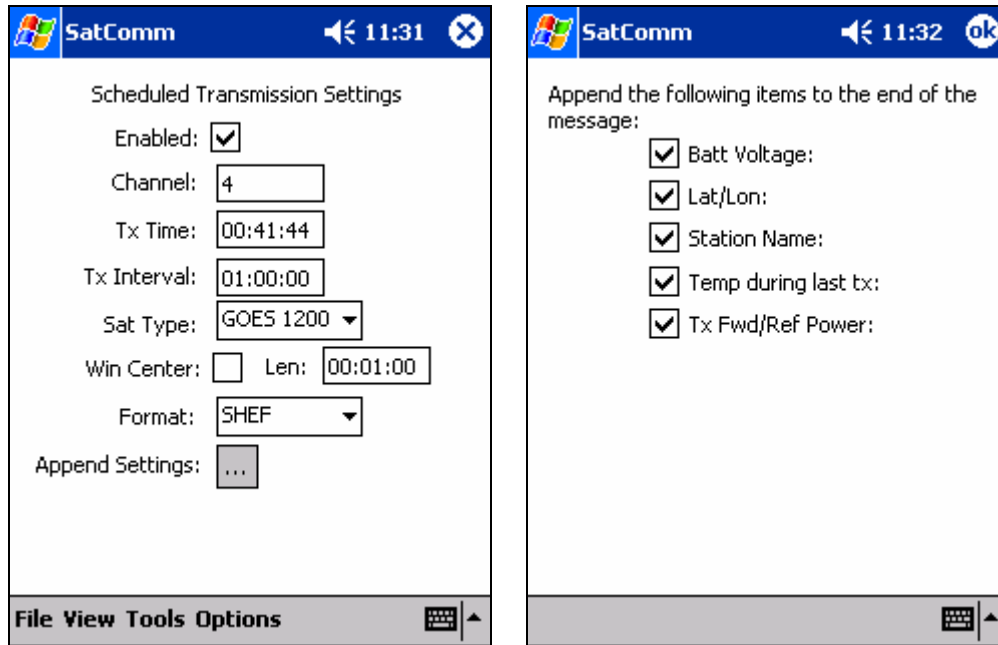
Transmission Settings

If scheduled transmissions are enabled by checking the "**Enabled**" box, then timed transmissions will occur at a regular interval. The scheduled transmissions are configured by filling out the fields on the Scheduled Tx tab. The Transmission time (Tx Time) , Interval, Channel and Satellite Type are assigned by the appropriate authority which manages the airwaves to be unique for each transmitter. NESDIS manages the details for all GOES transmissions.

On this page the Satellite ID cannot be changed. *Go to the Main tab to change the ID.*

All the transmission times for Satlink Logger are in the format of HH:MM:SS.

The "Append Options" attach additional information to the data transmitted,
Batt Voltage and Lat/Long will be appended regardless of the formatting type, but "Station Name" and "Temp during last tx" will only if the "Sensor data formatting" is set to SHEF or SHEFFIX.

The extra information is appended after external data (which is appended after sensor data). The battery voltage was measured during the last transmission (under load). Therefore the first transmission after bootup will report battery voltage of zero. If "Lat/Long" checkbox is marked, the coordinate information will be added to the end of the transmission. If SHEF or SHEFFIX is used to encode the transmission, the latitude and longitude will be in a readable format. If Pseudobinary is used, the information will be encoded into an 8-byte value. The formula for decoding this is located in Appendix E. "Station Name" will appear in the message just as it does on the "Main" tab of the Communicator. "Temp during last tx" is the temperature recorded by Satlink prior to the **last** transmission. "Fwd/Ref" power is the power level in Watts from the **last** scheduled transmission.

Window centering can be enabled for a scheduled transmission using the check box and associated interval. The length defines how much time is allowed for a transmission from the station. When centering is enabled, the transmitter will look at the length of each message that is sent and delay sending the message until it is centered in the transmission window. For example, a transmission which last 10 seconds which is scheduled for the top of the hour and has a window of one minute, would start 25 seconds past the hour.

Data Formatting

The "Sensor data formatting" box sets the format that Satlink Logger uses on the data it collects through measurements. This value does not affect data received from an external source. There are

three different format types: "SHEF", "SHEFFIX", "Pseudobinary", "ASCII Column", and "ASCII Sensor". Each has it's own distinctive advantages.

"**SHEF**" formats the data into readable ASCII messages. "**SHEFFIX**" is just a modified version of "SHEF" where the data is positioned in fixed spacing so that it will line up better when displayed. However, both the SHEF and SHEFFIX formats generally create long messages.

The "**Pseudobinary**" format encodes the data into 3 characters that you cannot read without the aid of a program. This format is over 50% shorter than the SHEF and SHEFFIX formats which results in shorter transmissions and lower power consumption. Although it is much harder for a person to visually inspect the data in this format, it is a much more efficient format for sending data.

"ASCII Column" and "ASCII Sensor" formats are similar to SHEF in that they create human readable and lengthy messages.

"**ASCII Column**" transposes the data, showing data from different sensors on each line. The columns will have data from the same sensor.

"**ASCII Sensor**" mode formats each sensor reading into four digits after multiplying the reading by 100. No decimal point is used in this format.

The specifics of formatting are covered in greater detail in Appendix E.

To see what your data will look like after it has been formatted, click the "Show Message" button.

Changing the settings in "Sensor data formatting" will automatically cause the "300/1200 Data Format" under the Advanced Scheduling tab to update to the most appropriate value for the type of formatting selected.

One important feature of Satlink Logger is Data Merge - its ability to transmit both data recorded from its own measurements in addition to data collected from another source, such as another logger. Each transmission consists of two separate parts. First, any data which has been measured by Satlink Logger directly through the Measurement functions is formatted and transmitted. After this, any data from an external source will be appended to the transmission. This data is stored in one of Satlink Logger's data buffers, as described later the buffer section.

User Initiated Transmissions

The "Transmit Now" control on the tab (Test page in SatComm) will cause the transmitter to make a transmission using the channel and satellite type information entered on the dialog. The software will warn you that a transmission is about to take place with the following dialog:
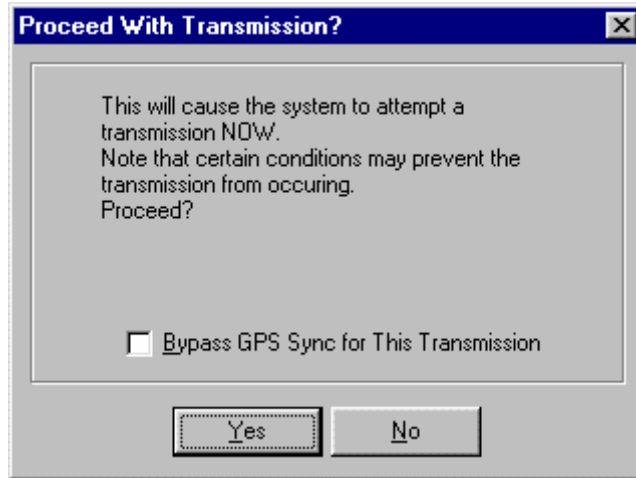
Manually forcing a transmission causes Satlink Logger to go through the same procedure as if it were making a regularly scheduled transmission. If any measurements are set up their data will be formatted and transmitted, then whatever data is in the buffer will be sent. If there is no data in the buffer, the message "Data Buffer Empty" is transmitted. Note that a user initiated scheduled transmission can only be generated when the unit is stopped.

If the "Bypass GPS Sync for This Transmission" checkbox is selected, Satlink Logger will forgo a few steps that usually precede the transmission. The steps skipped will result in a speedier transmission start. Also note that any transmission made outside the time slot assigned by NESDIS may interfere and disrupt the transmissions of other users. By requesting a transmission, the user is taken back to the main screen where the transmission time, status and any potential errors are displayed.

Data Buffers (Communicator Only)
The "Buffer Control" button will bring up the following window:
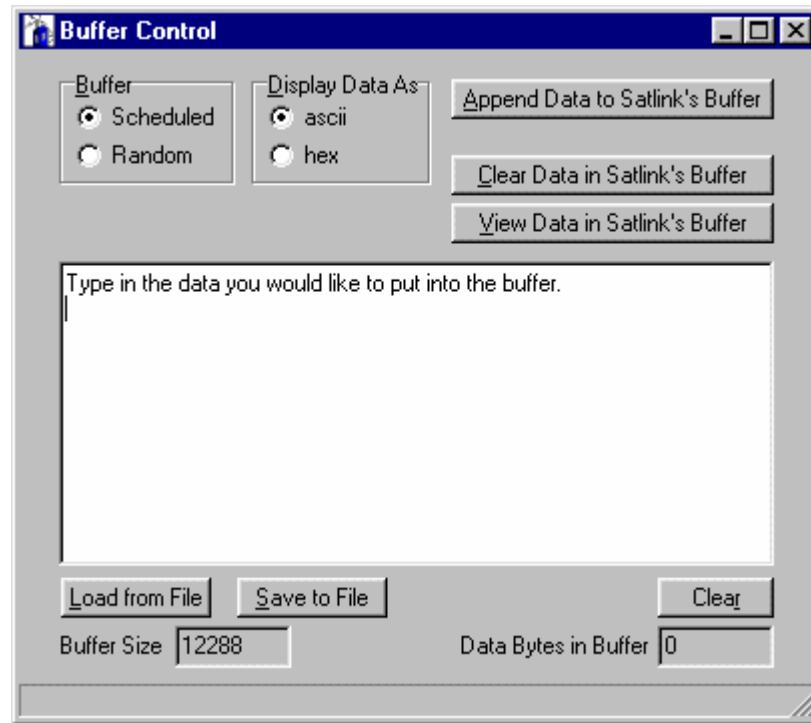
Satlink Logger's data buffer contains all of the external data that Satlink Logger receives from another source, such as another logger. This window will allow the user to examine, clear and append the data in Satlink Logger's Scheduled and Random buffers. Choosing a value in "Buffer" will allow the user to select which of Satlink Logger's data buffers to inspect. The buffers are independent of each other. Any commands issued to Satlink Logger through this dialog will affect only the selected buffer.

Hitting the "View Data in Satlink's Buffer" will read the data and display it for the user. Using this command will not affect the data in Satlink Logger's buffer. The "Clear Data in Satlink's Buffer" is used to delete all the data in Satlink Logger's buffer. "Append Data to Satlink's Buffer" will take the data displayed in the window, and append it to Satlink Logger's buffer.

Use the "Load from File" to put data from a file into the window, and use the "Save to File" to save the data currently displayed in the window to a file. Hitting the "Clear" button will only clear the data in the window, and will not affect the data in Satlink Logger's buffer.

"Buffer Size" will always indicate the size of Satlink Logger's buffer (this is the maximum number of bytes that can fit into Satlink Logger's buffer). "Data Bytes in Buffer" displays the number of bytes *currently* in Satlink Logger's buffer. The data may be displayed as ASCII or hexadecimal (by selecting the appropriate "Display Data As" radio button).

Transmission Message (Communicator Only)
The "Show Message" button will bring up a window that will show what a scheduled transmission message would look like. If the user is interested in finding out how long the transmission is, this is the place to find out. Satlink formats up the message just as if it were about to do a transmission, and then shows that message to the user. This means that it includes sensor data, external data, and any appended data (battery voltage, latitude and longitude).

This window contains other helpful information too. The length of the transmission (in bytes and seconds) is calculated and shown to the user. The user is informed how much of the data is sensor data, and how much of the transmission the sensor data could possibly take up is also shown. A

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message may vary in length, depending on the type of sensor formatting selected. SHEFFIX and pseudobinary formatting result in fixed length data. However, SHEF messages vary in length. This is because the number of digits in a reading (12.5 opposed to 125.5), and because the first few transmissions are likely to have missing data (which is formatted as 'M').

In this window, Satlink also tells the user how many measurements are active and how many readings are set to be transmitted. These settings can be modified in the Measurement Tab (see section Transmissions and Measurements page 57).

This is what a transmission data window will look like:

21300 RIDGETOP CIRCLE
(703)406-2800
STERLING, VA 20166
(703)406-2801 FAX
WWW.SUTRON.COM
SALES@SUTRON.COM
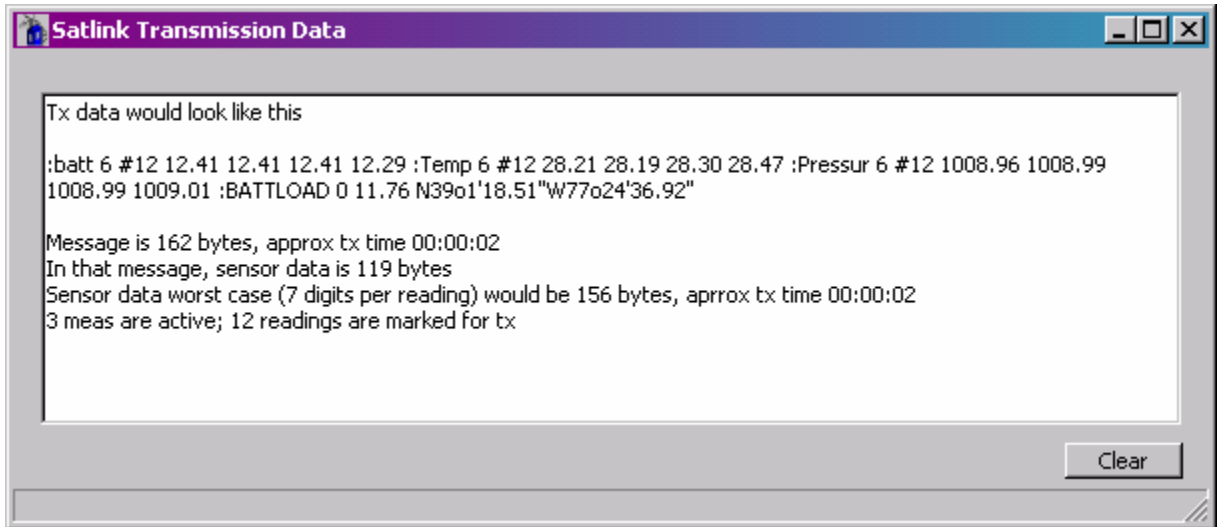
ADVANCED SCHEDULED TX SETTINGS

This tab will allow the user access to advanced settings pertinent to the scheduled transmission.
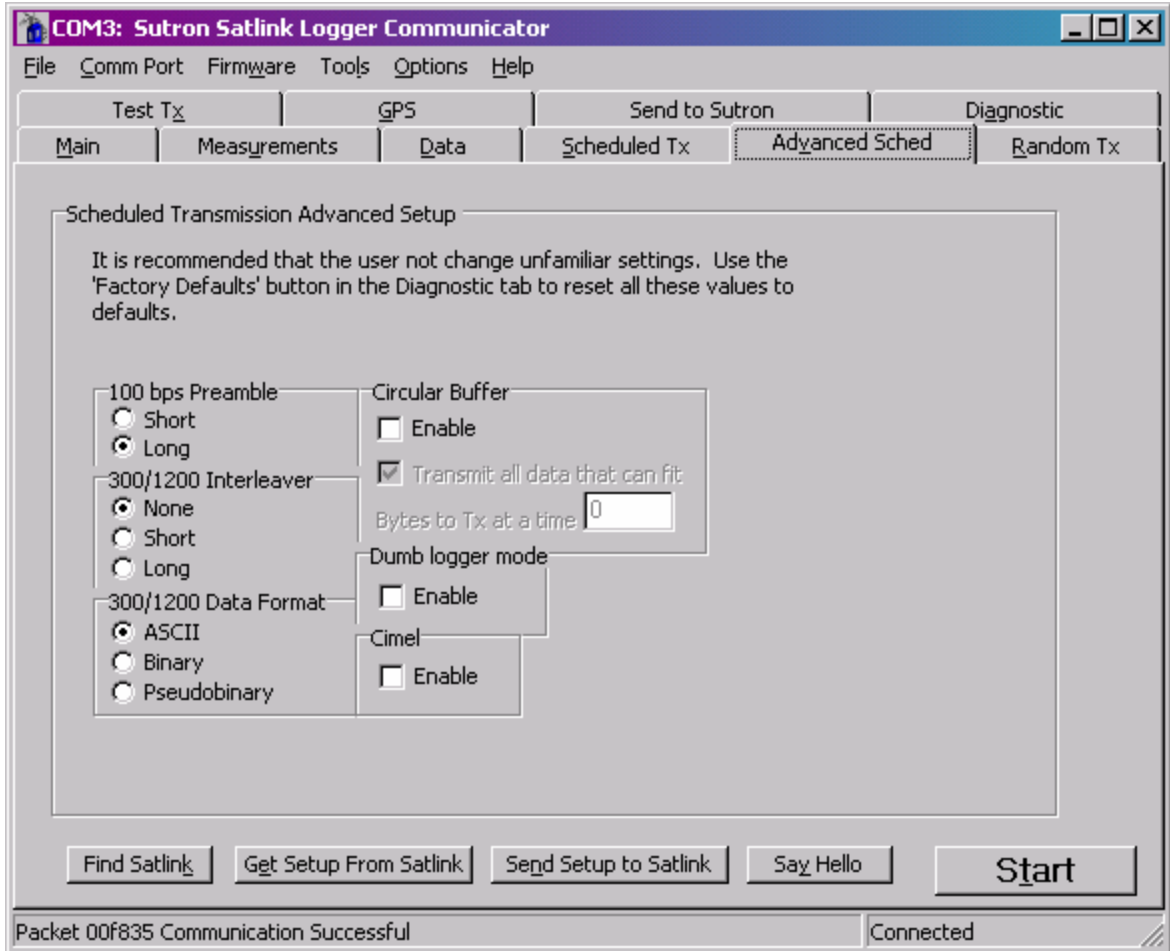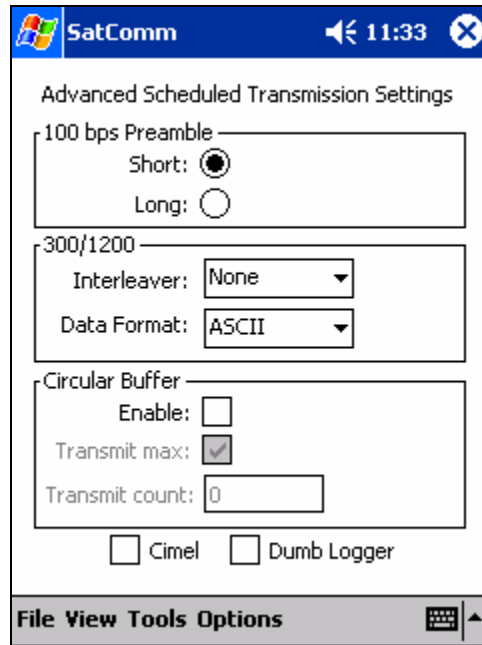
There are two group boxes that are relative to the Satellite Type. The "100bps Preamble" box gives the user the options of "Short" or "Long" preamble. A short preamble will result in the transmission having a much shorter carrier length.

The "300/1200 Interleaver" can be set to either "None", "Short", or "Long". Setting the interleaver to "Short" or "Long" will cause any potential errors in the transmission to be spread out over the whole message, thus allowing for an easier error correction. Typical transmissions only need to use the default, or "None" interleaver.

It is strongly recommended that the user does not change the "300/1200 Data Format" setting. This will not affect how the data from Satlink Logger's sensors is formatted. Instead use the "Sensor Data Formatting" box under the Scheduled Tx tab to select a format type (SHEF, Pseudobinary, etc.). This will automatically set the "300/1200 Data Format" to appropriate values for the desired format.

Circular Buffers allow different handling of the data in Satlink Logger's buffer. If they are enabled, Satlink Logger will transmit only so much data every time, and keep the rest for the next transmission. If a number of bytes to be transmitted is specified ("Bytes to Tx at a time"), then Satlink Logger will transmit only that many bytes, and leave the rest of the data in the buffer for the next transmission. If "Transmit all data that can fit" is selected, then Satlink Logger will transmit all the data that can fit into the transmission. (All transmissions are time limited).

**If Circular Buffers are not enabled, Satlink Logger will throw away any data it cannot fit into the transmission.**

Dumb Logger Mode

The "Dumb Logger" mode is used to have Satlink transmit data from a logger that does not speak the Satlink serial port communications protocol. If this mode is enabled, any data coming into the serial port that is not of Satlink protocol gets put into the scheduled transmission buffer.

In order for Satlink to accept data from another logger, besides having the dumb logger mode enabled, the user must ensure that the logger talk at 9600 bps, 8 data bits, no parity, one stop bit, no flow control. There are two ways to wake Satlink up: either assert RTS or send a wake up character. That wake up character should be binary 0. After waking Satlink make sure to wait at least 6 milliseconds. After Satlink is woken, it will acknowledge by asserting CTS. If woken with a character, Satlink will stay awake for five seconds after the last character comes in. If woken with

an RTS, Satlink will stay awake for as long as RTS is asserted. Note that you are likely to need a null modem in order to connect logger to Satlink.

It is actually possible to send data to Satlink without a wakeup character or RTS. What happens is this: Satlink is sleeping whilst keeping its clock running at 600kHz (min speed required to talk 9600). This pulls about 0.1mA more than non dumb logger sleep. Once Satlink gets the first incoming character, it wakes and takes about 6ms to restore its clock to normal frequencies. During this time, any incoming characters may get corrupted. As long as more than 6ms pass between the first and the second chars, Satlink catches all of them. In some cases, if the chars are very close together, Satlink will catch them all before speeding up his clock. Since RS232 does not guarantee the in-between character timing, success depends on the connected device.

The "Cimel" mode should be used when Satlink is to collect data from a CIMEL logger. In this mode Satlink will, prior to transmission (at the same time it does the GPS satellite acquisition), grab data from CIMEL and treat it as it does external data. For more information on external data see the buffer section.

RANDOM TX

This tab defines how to send random or unscheduled transmissions. A diagram is shown below.
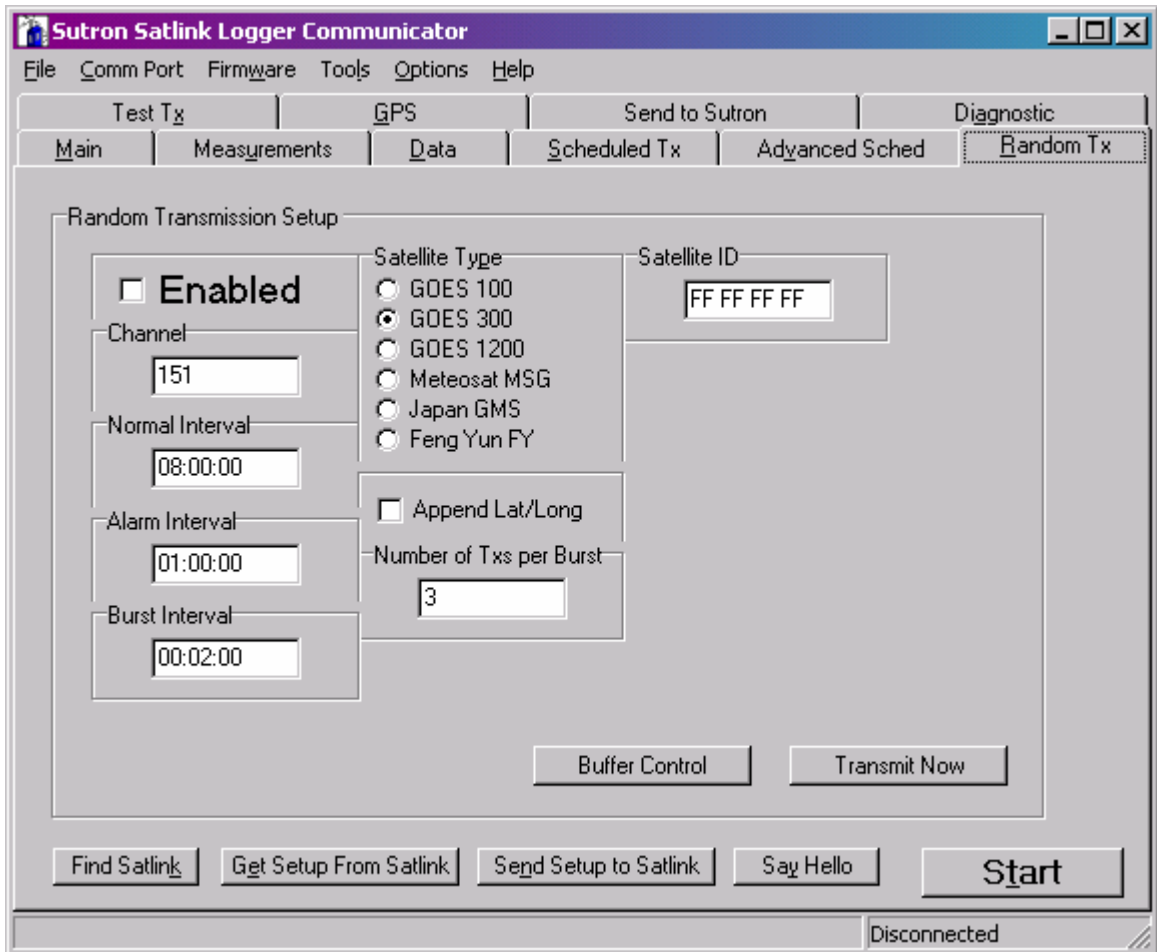
If they are enabled, how often random transmissions occur depends upon the alarm status. Alarms can be set up for individual sensors through the Measurements tab under the "Alarm Settings." If the sensors are not in alarm, Satlink Logger will make transmissions at a rate determined by the "Normal Interval". When the sensor enters and/or exits alarm mode, Satlink Logger will make a series of transmissions called a burst. The number of transmissions in a burst is defined by the user. Normally, alarm transmissions are repeated multiple times because there is no guarantee that a single message will make it through. It is common to set the "Number of Tx per Burst" ("Num Bursts" in SatComm) to 3 to increase the chance that the alarm gets through. The "Burst Interval" defines how much time passes between attempted transmissions. Note that if a second sensor enters alarm mode while the first sensor is waiting for a burst, the first sensor's bursts will be cancelled and the second sensor will begin its bursts. For more information on how to set up burst transmissions see the Alarms section of the manual. While any sensor is in alarm and burst transmissions are finished, Satlink Logger will transmit at the rate set by "Alarm Interval".

The Random Transmission Setup also defines the Channel, Satellite Type and ID, and the "Append Lat/Long" checkbox. These values are similar to their scheduled transmission counterparts but apply to random transmissions and channels. Note that the Satellite ID is shared with scheduled transmissions; it is not possible to set up a different ID for scheduled and random transmissions. On this page the Satellite ID cannot be changed. Go to the Main tab to change the ID. "Transmit Now" and "Buffer Control" also work the same as would a scheduled transmission, with the exception that a random transmission can also be forced, either manually or by a signal from another logger unit, while the system is running. The channel and BPS for a forced transmission will reflect the values chosen for random transmissions.

TRANSMITTER TEST (COMMUNICATOR ONLY)

This tab allows the user to exercise the transmitter to verify all its functions. It is also useful when trying to troubleshoot difficult problems.
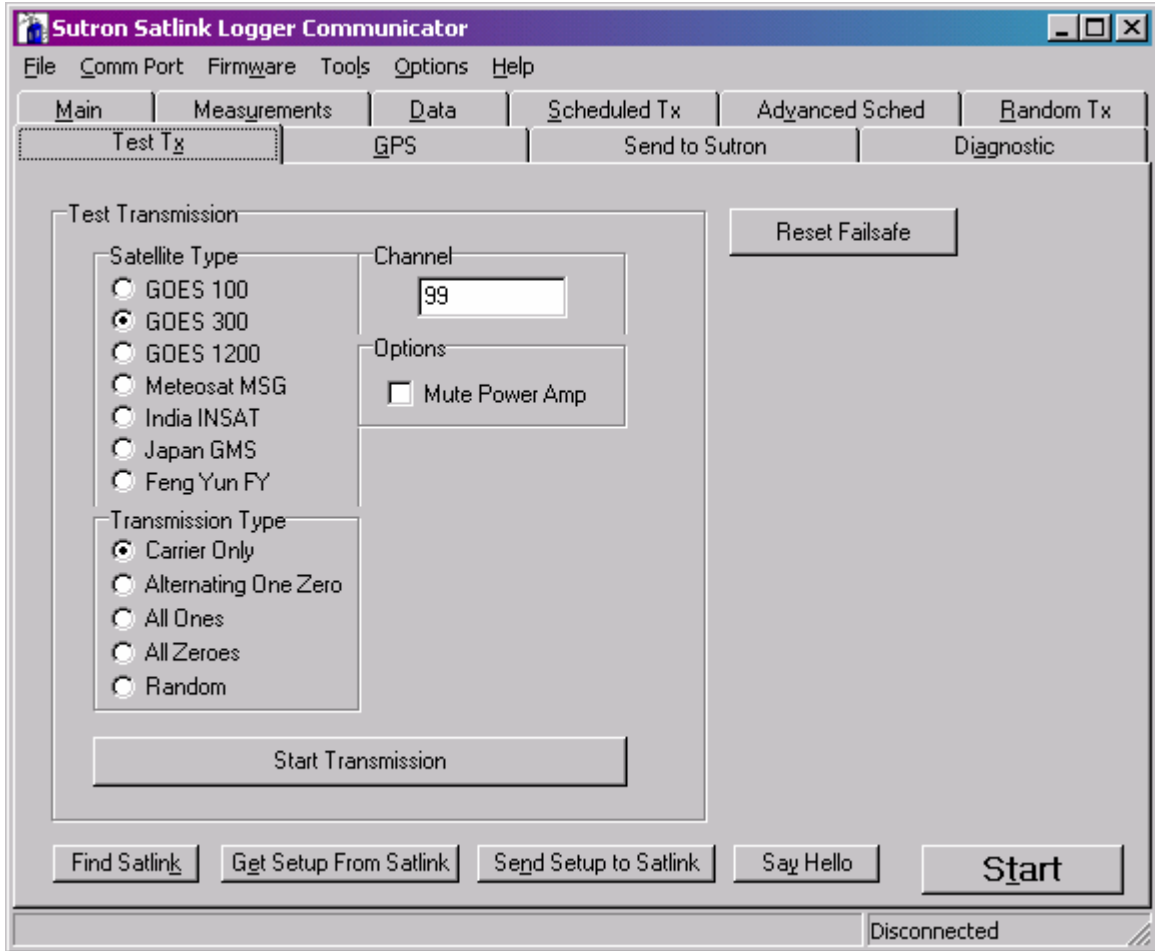
The Test Tx functions should only be performed by someone trained in the operation of the transmitter. They should never be done with an antenna connected as the tests can disrupt the transmissions from other stations.

Warning: Never perform tests with the antenna connected as violation of transmission assignments may occur.

To make test transmissions, first select the "Satellite Type", the "Transmission Type", and the "Channel". Select "Mute Power Amp" if you want to test the modulator board without turning on the amplifiers. After making the selections, press Start Transmission. The following window will show:

Information

Test transmission requested. Satlink should start transmitting immediately.
Hit OK to STOP transmission.

OK

The transmission can be left on for observing the signals using scopes and analyzers. To turn off the transmission, hit OK. If you do not stop the transmission in time, the failsafe will trip.

SATLINK 2 LOGGER AND TRANSMITTER OPERATIONS & MAINTENANCE MANUAL

GPS

The details of the GPS tab are as follows:
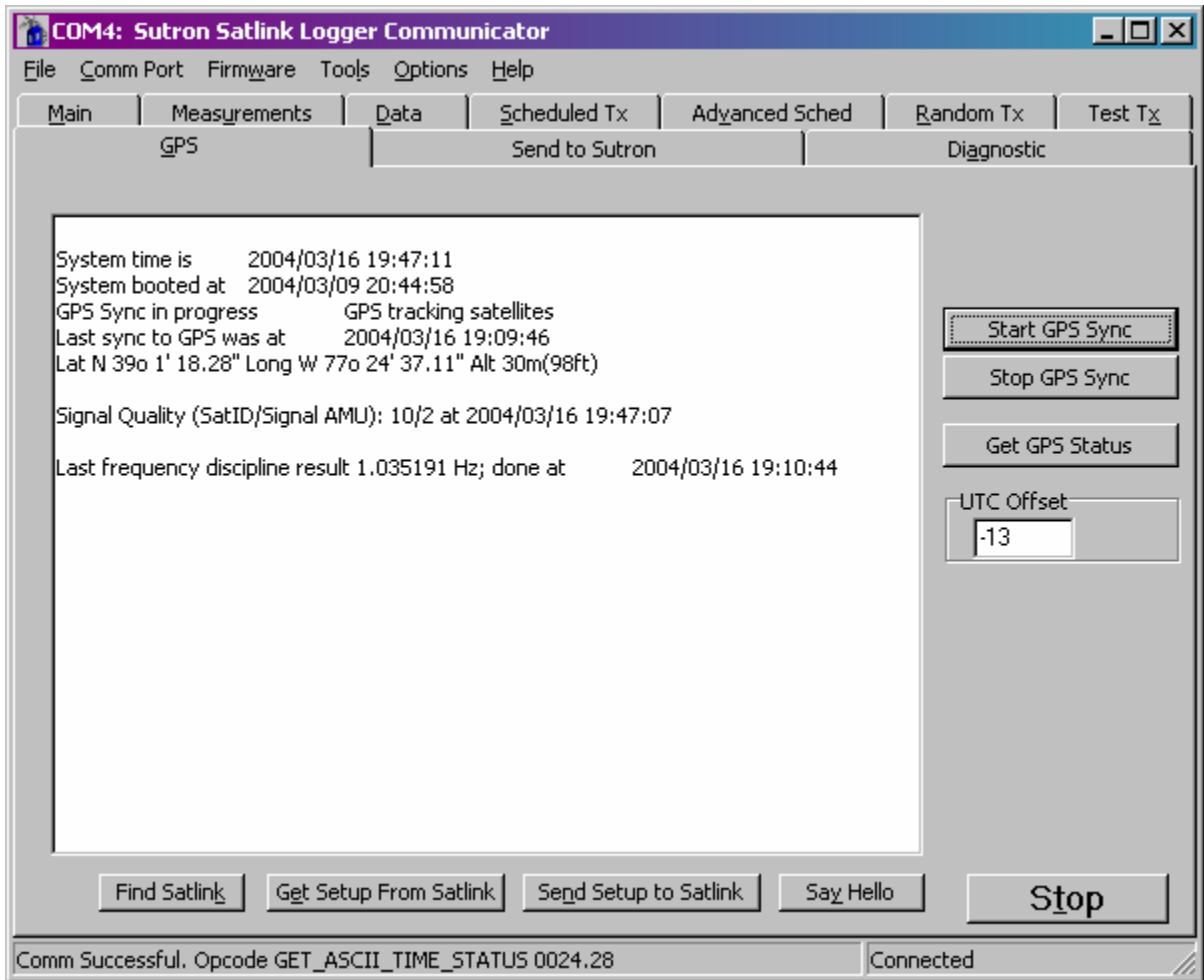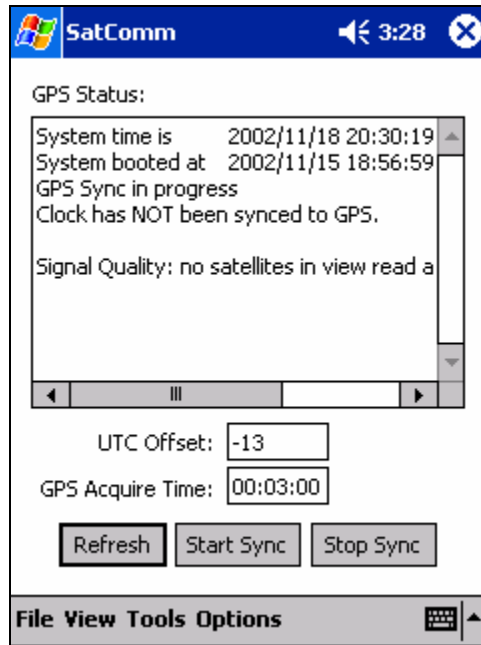
All the times for Satlink Logger are in the format of YYYY/MM/DD HH:MM:SS and are based on UTC (Universal Coordinated Time).   YYYY means four digits that indicate the year.

Every Satlink Logger transmitter has a built-in GPS module. The GPS module has the ability to get the time from the satellite. The GPS module needs to be connected to an antenna and that antenna needs to have a clear view of the sky so the GPS can track the satellites. Satlink also contains an internal clock. Satlink will frequently update its clock to the time reported by the GPS module. You never need to set Satlink's time.

The status reported will indicate the current system time (note that the communication between the PC and the Satlink will include a delay which will cause the time displayed to be off by a second or two). System booted indicates when the Satlink was powered up. The status will also indicate whether and when Satlink's internal clock has been synchronized to the time reported by the GPS module. After this information, Satlink will report its position in terms of latitude and longitude.

In order to give the user a better idea of the quality of the GPS signal, Satlink Logger provides messages that indicate how long the GPS module was powered before a time sync was initiated. If the last GPS sync was a part of a transmission, this number should roughly be equal to the GPS acquire time. If the last sync was user initiated, then this number will indicate how long it took the GPS module to acquire the signal necessary to provide an accurate time.

The Signal Quality reported by Satlink consists of a sequence of paired numbers. The first number is the number of the GPS satellite and it is followed by the signal strength of that satellite. The higher the signal strength, the better the signal. The more satellites the GPS can see, the better the signal.

Satlink will come equipped with either a Leadtek GPS (older Satlinks) or a Trimble GPS (newer models). To find out the model in the current Satlink, check the firmware version (in the "Firmware" menu). Leadtek models provide their signal strength in units of SNR. Trimble provides satellite strength in units of AMU.

For example, a Leadtek message:
Signal Quality (SatID/SNR): 10/39 17/40 24/40 06/34 30/34 04/39 05/38 13/36 at 2004/03/16 19:48:05
Indicates that 9 satellites are visible. The first entry 10/39 tells us that satellite number 10 has a signal strength of 39 SNR. The second entry 17/40 tells that satellite number 17 is providing a signal 40 SNR strong.

A Trimble message would look like this:

> Signal Quality (SatID/Signal AMU): 5/4 6/3 10/6 17/4 24/6 at 2004/03/16 19:44:10

Five satellites are visible. 5/4 means satellite number 5 is providing a signal with a strength of 4 AMU. The lowest useful signal strength is 2 AMU.

Last frequency discipline result, as reported in the GPS status, shows the compensation made by Satlink in order to overcome drift by its oscillator. Satlink automatically compensates for any drift of the oscillator used to create the transmission frequency by measuring the oscillator against the ultra accurate one Hz signal coming from the GPS.

The "Start GPS Sync" button ("Start Sync" in SatComm) forces the Satlink Logger to begin acquiring the time and location information from GPS. After pressing "Start GPS Sync" the text box will report on the status of the calibration test when it is refreshed. Typically, the system will take 30 to 45 seconds to acquire position fix information and 10 to15 seconds to acquire time. If the system takes longer than this to acquire the time, you may need to reposition the GPS antenna. As a last resort, you may need to increase the acquire time to allow the station more time to acquire signals from the GPS satellites.

Use the button labeled "Stop GPS Sync" ("Stop Sync" in SatComm) to stop a user initiated GPS acquisition.

"Get GPS Status" ("Refresh" in SatComm) should be used to refresh the GPS information shown. Note that as long as Auto Update is selected from the Options menu, the Communicator program will do this automatically every few seconds.

The field labeled UTC offset tells Satlink the difference between UTC and GPS time. This field is only applicable to Satlinks with a GPS module version LD03. UTC and GPS time will drift after an extended time period. At the time of writing (March 2004) this offset was -13 seconds.

SEND TO SUTRON (SATCOMM TEST)
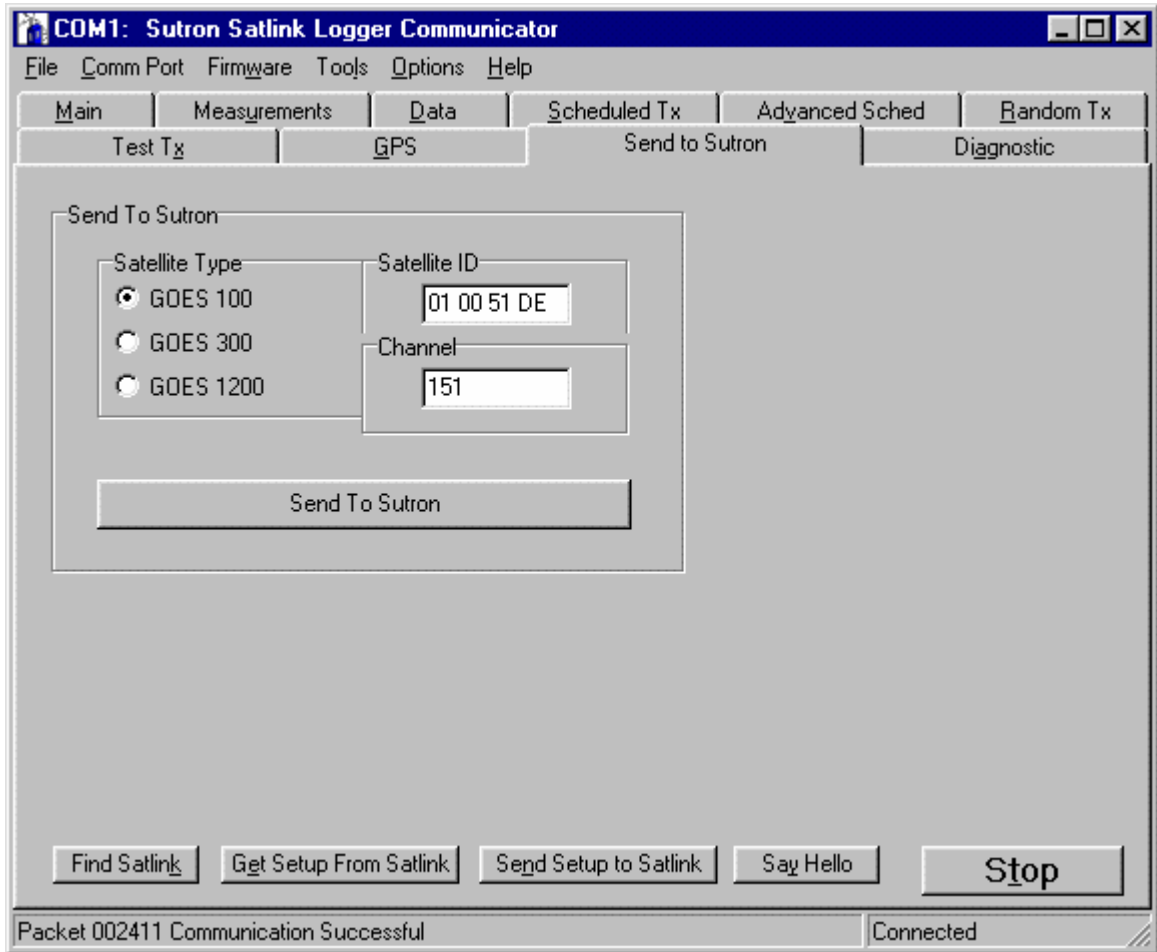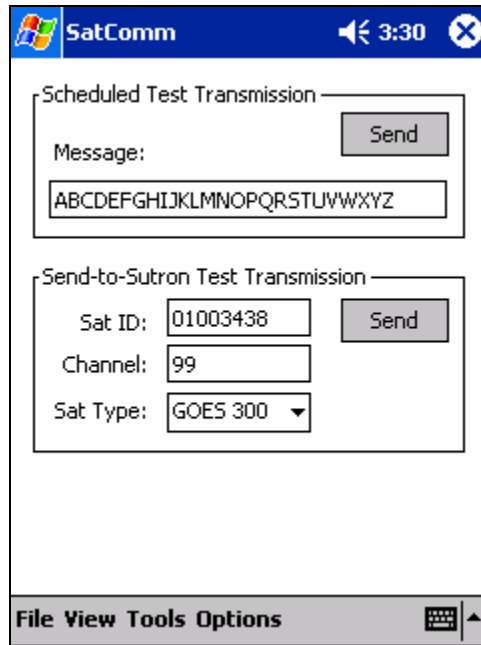
The Send to Sutron tab in Communicator, and the Send-To-Sutron Test Transmission portion of the SatComm Test page, are used to send a transmission over the air using the Channel and Satellite ID assigned to Sutron Corp. This function is to be used to make sure that Satlink Logger is working properly. As Sutron Corp. will receive the message, the user needs to be in touch with customer support before using this feature.

The "Satellite Type", "Satellite ID" and "Channel" settings should be set to those belonging to Sutron Corp., **not** to those belonging to the customer.

Hit the Send to Sutron button to initiate a transmission. The program will then prompt you for confirmation, and return to the Main tab where the status of the send to Sutron transmission will be shown. The transmission may or may not start immediately, depending on what Satlink Logger is doing at the time.

Note that the system needs to be stopped in order for test transmissions to take place.

SatComm also allows the user to send a test transmission using the current scheduled transmission parameters using this page. The button "Send" is used to send the contents of the Message window. Stop Satlink before sending a message in this fashion.

DIAGNOSTIC (COMMUNICATOR ONLY)

The Diagnostic tab offers two features: Capturing debug information and setting Satlink Logger to its factory defaults.
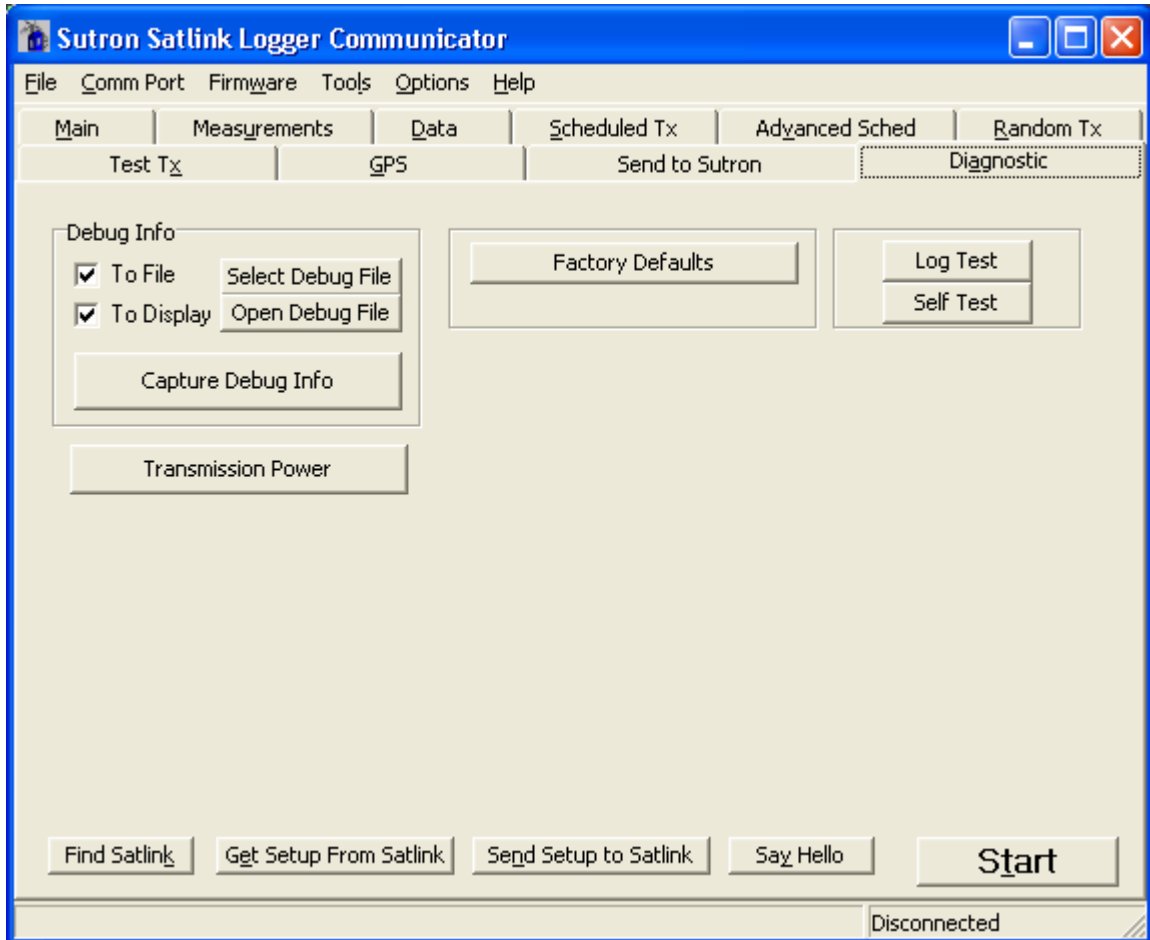
"Log Test" is used to perform a destructive log test. This procedure will validate the workings of Satlink Logger's log chip. **This procedure will destroy all data in the log.** The user should not invoke this test unless instructed by Sutron personnel.

"Self Test" can be used to help troubleshoot a malfunctioning Satlink. By pressing the button (and resetting Satlink if the program asks for it) a boot-up self test is started and the results are displayed to the user. This feature is helpful in finding out whether a Satlink needs to be sent back to Sutron for repair.

Use the "Capture Debug Info" button to have Satlink Logger output detailed information about its internal states. This debug info may be shown real-time, it may be logged to a file, or both.

If the "To File" box is checked, the user will be presented with "Select Debug File", a button that allows the user to specify where to save the debug info, and an "Open Debug File" button which will open the log file for inspection using the local text editor.

If the "Transmission Power" is selected, then the ability to determine the forward and reflected power from the last transmission is possible. If no transmission has been made since boot up, the display will read 0.0/0.0 watts

If the "To Display" box is checked and the "Capture Debug Info" button is clicked, the debug info will be shown in real time. Depending on the setting in the Options menu, the info will be shown either as part of the Diagnostic tab, or in a separate window:
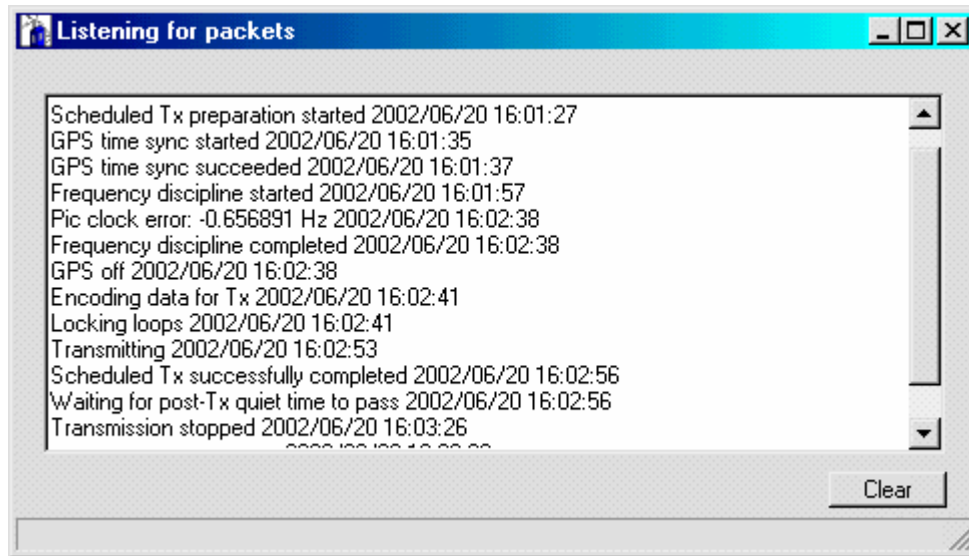
The debug information displays the exact times for measurements and transmission, as well as other vital information. Debug can be rather cryptic and meant for the advanced user. It is meant to be an aid in troubleshooting.

Disconnecting from Satlink Logger's RS-232 port or closing the Communicator Program causes Satlink Logger to disable debug output.

Hit the "Factory Defaults" button and a confirmation dialog will appear. This command is meant to be used by the production personnel prior to shipping a unit. The effect of this command is to reset many settings kept in permanent memory such that the customer is presented with a unit in a known state of affairs. The following settings are modified.

Set Station Name is set to Homer.	The satellite ID is set to 0xFFFFFFFF.
Low power mode is enabled.	System status is cleared.
Debug Set Debug Port is set to no debug messages.	Bootup mode is set to no messaging.
Autostart is disabled.	Scheduled transmissions are disabled.
Scheduled channel is set to 195.	Scheduled offset is set to 00:00:00.
Scheduled interval is set to 04:00:00.	Scheduled satellite type is set to 300 BPS.
Scheduled window length is set to 00:01:00.	Scheduled window centering is disabled.
Scheduled interleaver is set to no interleaver.	Scheduled data format mode is set to ASCII.
Scheduled preamble length is set to long.	Scheduled sensor data formatting is set to SHEF.
Scheduled circular buffer is disabled.	Random transmissions are disabled.
Random channel is set to 151.	Random normal interval is set to 08:00:00.
Random alarm interval is set to 01:00:00.	Random burst interval is set to 00:02:00.
Random number of transmissions is set to 3.	Random baud rate is set to 300 BPS.
Random interleaver is set to no interleaver.	Random data format mode is set to ASCII.
Send to Sutron settings become GOES 100, Channel 151.	Send to Sutron Satellite ID becomes 01 00 51 DE.
GPS Module use is enabled.	GPS baseline interval is set to 02:00:00.
GPS acquire time is set to 00:03:00.	GPS time validity is set to 04:01:00.
For every measurement the following will happen.	Label is set to blank (no label).
Active is set to false.	Relative to Tx is set to false.
Time is set to 00:00:00.	Interval is set to 00:15:00.
Right Digits is set to 2.	Slope is set to 1.
Offset is set to 0.	Include in Scheduled is set to false.
Include in Random is set to false.	Num to Tx is set to 4 for both transmissions.
Measurement type is set to SDI-12.	SDI-12 Cmd is set to nothing (blank).
SDI-12 Param is set to 1.	Manual Measurement is set to 0.
All alarms are disabled.	All alarms limits are set to 0.
Alarm Deadband is set to 10.	Tipping Bucket Count is set to 0.

UPGRADING SATLINK FIRMWARE

It is possible to upgrade Satlink's firmware by using the Satlink Logger Communicator and SatComm. On Communicator, accessing the "Upgrade" entry of the "Firmware" menu produces the following dialog:
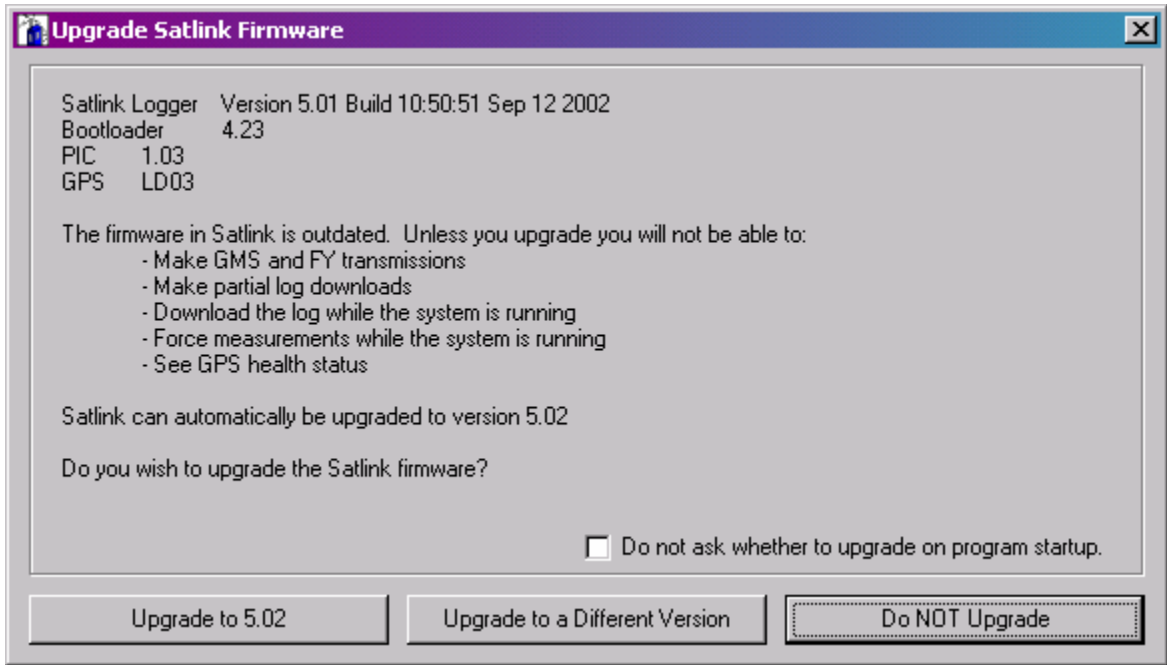
This dialog will inform the user if he has an outdated version that needs to be upgraded.. If the Communicator fails to upgrade Satlink, please refer to the section titled "Self Test on page 101 of the Troubleshooting chapter.

On SatComm, selecting the "Tools – Upgrade Firmware…" menu allows the user to select the upgrade file to use. When copying upgrade files to the Pocket PC device, put the files into "\My Documents\SatComm".

Chapter 6
Installation

PROCEDURE

Satlink Logger is used in one of three configurations: stand-alone, operation with 8210, and operation with Xpert/XLITE. Installation of Satlink Logger in each of the configurations is detailed in the following sections. Careful attention to the supplied installation notes will benefit the user with years of trouble-free operation.

In order to properly use Satlink Logger, you must first be familiar with the Satellite system on which Satlink Logger operates. If you are planning to operate your Satlink Logger in North or South America, you will be using the GOES satellites operated by NESDIS. Currently there are two satellites in geostationary orbit in the NESDIS DCS system. In order to make transmissions on the satellites, you will need to contact NESDIS and fill out their required applications. The main web site for NESDIS DCS is http://noaasis.noaa.gov/DCS/. After completing the applications you will be assigned an ID, transmission time, interval and channel.

NESDIS requires that you keep the PDT file up to date for any station operating in the system. Whenever you deploy a station or move it, you should make the appropriate changes in the PDT file.

Stand Alone Installation

Stand-alone installation refers to the installation of Satlink Logger in a manner that has Satlink Logger as the master either with SDI sensors connected directly or other data loggers passing data to Satlink Logger for transmission.

STEP 1:

Mount Satlink Logger on a solid surface preferably on a wall in a typical gauge house or similar building. If Satlink Logger is to be exposed to excessive moisture or conditions that may compromise its exposed connectors, it is recommended to place Satlink Logger in a small Nema-4 enclosure. Attempt to locate Satlink Logger in a place where opening the door in a storm will prevent water from reaching it.

It is recommended to firmly attach Satlink Logger to the mounting surface such that any pulling on the cables will not yank the transmitter to the ground. Convenient keyhole mounting slots have been provided such that 4 pan head screws may be installed within about 1/8 of an inch of the surface. Then Satlink Logger may be dropped over these screws and pulled to one side. The four screws need not be tightened as two additional locking screw holes have been provided.

STEP 2:

Connect the Transmitter Output (SMA-female) to the Satellite uplink antenna. Typically, the satellite antenna cable is an RG-8 cable. It is not recommended to directly attach an RG-8 cable to an SMA connector unless the cable is firmly secured to the wall or surface. This will prevent the breaking of the SMA connector on Satlink Logger's Front Panel when the rather large and rigid RG-8 cable is pulled firmly. Alternately, if Satlink Logger is dropped into an enclosure of any type, it is recommended to use a small and flexible cable such as RG-58 with an SMA connector on one end and an N-type on the other end to connect to the external 15 foot RG-8 cable. The use of a lightning arrestor is another example of an easy method of connecting the small SMA/RG-58 cable to the larger RG-8 cable. Carefully point the satellite uplink antenna at the desired satellite after determining the azimuth and elevation required.

STEP 3:

- Connect the GPS antenna to the SMA connector provided on the end panel of Satlink Logger. Be careful not to connect the GPS antenna to the incorrect SMA connector on the end panel of Satlink Logger. Install the antenna with the following items in mind.
- Place the GPS antenna in the most open space possible. Do not place it directly under anything nor directly beside something. Always attempt to achieve a "full sky" view with the antenna.
- Place the GPS antenna high up on a pedestal or in a protected location. Flat surfaces may tend to cover with ice and snow more so than elevated locations. Keep away from areas where birds may nest.   Placement is very important and great care should be taken in selecting the location.
- If the surface is metal, the antenna is a magnetic mount that will stick to the surface very easily. If the mount is a non-ferrous material, attach the antenna with double sided tape or a tie down mechanism.

STEP 4:

Connect Satlink Logger's DC power cable to the battery/charger system being careful not to short out the battery or reverse the cable. Note that a fuse is installed in the cable in the event that the power cables are reversed.   Upon the reversal of power, a protection circuit will blow the fuse. Always replace with a 3AG size fuse rated at 8 amps (SB).

STEP 5:

Connect SDI-12 sensors to Satlink Logger. If you are using multiple SDI sensors and the address has not been set for the sensors, only connect one of the sensors at this time.
Connect a tipping bucket to the Sensor Connector on the front of Satlink (on some older models, this connector is labeled "I2C"). On that connector, use pins 9 (high) and 5 (low) to connect to the tipping bucket.

STEP 6:

Connect the serial port to the PC for testing or to another logger device to feed data into Satlink Logger. If you have already created a setup for the station load it into the Communicator program by opening the file it is stored in. Otherwise, Use the Measurement page to specify how the data is measured, logged and transmitted. Use the Scheduled Tx page to setup the scheduled transmissions and the Random Tx page to setup the random transmissions. When you have finished creating the setup, press "Send Setup to Satlink" to load it into the Satlink Logger.

STEP 7:

While on the Measurement page, you may configure any SDI sensors that need configuration. Use the Send SDI-12… button to send the desired configuration commands to the SDI-12 devices. You will need to refer to the operator's manual for each specific SDI-12 sensor to know which commands to send. You may also send commands to make measurements and operate the SDI-12 sensor.

You may also want to force some measurements to make sure the sensors are operating properly. Use the Force button to force Satlink Logger to take a measurement of the sensor selected.

STEP 8:

Press the "Start" button at the bottom right of the display. This causes Satlink Logger to begin to use the schedule to make automatic measurements and transmissions.

Go to the Main tab and verify the system status. It should say that the system is running, that measurements are active, and that transmissions are enabled.

STEP 9:

Go to the Data tab and select a measurement that you have set up. Once a measurement has been made (according to the schedule you have made), hit the refresh button to see the data collected by Satlink Logger.

You may find out when the soonest measurement is supposed to occur by going to the Main tab.

8210 Internal Installation

8210 with Satlink 2   8210 with Satlink 2 and Speech Modem

STEP 1:

Repeat the same process as the stand-alone version with the following exceptions:
- If Satlink Logger is not meant to do anything on its own, i.e. independently of the 8210 such as make measurements, it is important to set Satlink Logger to Factory defaults.
- The serial port is connected to the special db-9 board provided within the 8210.
- The DC power is provided via the top most of the 3 white power connectors provided on the side panel of the inside of the 8210.
- The GPS cable will pass through the enclosure and directly connect to Satlink Logger. Plug the opening with the supplied cable gland.
- A special RF output cable is provided bringing the RF output power over to the side of the 8210 with an N-type connector.

8210 External Installation

The 8210 external arrangement is the same as the internal 8210 connections with the following differences:
- Use a standard DB-9 cable to connect Satlink Logger's serial port to the DB-9 connector provided on the bottom of the 8210.
- Power Satlink Logger directly to the battery using the provided connectors.
- Use a short cable to adapt the SMA RF output connector on Satlink Logger to the RG-8 antenna cable.

Xpert Installation

The Xpert connection is the same as the 8210 external connection except that the Xpert is used in place of the 8210.

Optional Items

In locations with heavy lightning exposure, it is recommended to use a lightning arrestor. Typically, bulkhead mount types are attached to the side of an enclosure or other available surface. Good grounding is essential for proper operation.

Chapter 7
Maintenance and
Troubleshooting

TROUBLESHOOTING

Q: How can I troubleshoot my Satlink Logger site?

***A*: Equipment Needed:**
Bird model 43 Wattmeter (or equivalent)
Bird 25 watt element
Bird dummy load capable of 25 watts
Good RF cable (shorter cables have less loss)
A SMA male-to-male Type N adapter

1. Force a transmission, measure, and record output power of transmitter. This is done by connecting the test RF cable to the transmitter and wattmeter, with the dummy load on the output of the wattmeter.
2. Force a transmission, measure, and record output power of transmitter. Now connect the site's RF cable to the wattmeter, with the dummy load on output of the wattmeter. Subtract this value from the value recorded in Step 1. There should be less than a 2 watt loss in the RF cable. If there is more, the cable needs to be replaced/repaired.
3. Now connect the antenna to the output of the wattmeter (you will need the SMA male-to-male Type N adapter or a short cable providing the same adapting capability to do this) leaving the site's RF cable connecting the transmitter and the wattmeter. Force a transmission on your random channel (so that you do not walk on someone else's scheduled transmission). Measure the reflected power of the antenna by turning the wattmeter element so that the arrow faces away from the antenna. There should be less than a 1/2 watt of reflected power. If there is more, the antenna needs to be replaced/repaired.
4. Now connect the wattmeter to the transmitter with the test RF cable. Connect the site's RF cable and antenna to the wattmeter's output. Force a transmission on your random channel, measure the reflected power of the site's RF cable. There should be less than a 1/2 watt loss of reflected power. If there is more, the cable needs to be replaced/repaired.

Part Numbers:
5000-0080	Antenna, YAGI Satellite
5000-0081	Antenna, YAGI Satellite with stainless steel elements
6411-1162-1	Cable Assy, Antenna, 15 ft

Q: Why will my Satlink Logger not turn on?

***A*:** When first powered up, the red light on Satlink Logger's front panel should turn on and blink. If no lights turn on, check to make sure power is running to the unit.
1. **Are the power cords connected properly?** Check Satlink's connection to the power supply for a bad connection.
2. **Does the battery have a good charge?**
3. **Is the fuse on the power cable blown?** Satlink Logger requires a 3AG, 8 AMP, slow blow fuse in order to operate.
4. If power is properly supplied, but the unit still does not turn on, call Customer Service for assistance.

Q: The LED on the front panel blinks, but the Communicator still cannot find Satlink Logger?

***A*:** Did the unit boot up properly? See Depot Level Troubleshooting for the boot up sequence.
1. If it booted up properly, the light should blink once every five seconds. If it doesn't do this, contact Customer Service.
2. If the five second heartbeat happens as expected, but the Communicator still cannot find Satlink Logger, check the serial port connections to make sure they are properly connected.
3. Make sure that COMM port is not being used by another program such as HyperTerminal or even another Satlink Logger Communicator. In this case Satlink Logger Communicator will say it cannot open the COMM port.

Q: Why is my sensor not recording data at all?

A: Is the most recent data displayed? Press "Refresh Data" on the Data tab to get the latest data.

A: Check to make sure that the measurements are being made
1. Go to the Main tab and press "Get Status." This should display Satlink Logger's current configuration.
2. **Is the System running?** If the system is stopped press the Start button.
3. **Are the measurements active?** The status should display which measurements are active. Check to make sure that the box "Active" is checked for the measurements you want to record. The user can also check this by viewing "Index" on the Data tab. Active measurements have asterisks by them.
4. **Is the interval set for the right time?** Check that you have the proper interval and time set. The time for the next measurement should be displayed. Note that the red LED on Satlink Logger should blink twice when a measurement is made

Q: Why is Satlink Logger occasionally skipping measurements?

A: Considerable effort has gone into making sure Satlink Logger will accurately record measurements. However, certain scenarios could cause Satlink Logger to miss an occasional measurement.
1. **Measurement interval too short –** This error is returned when the interval for recording measurements is too short for the sensors to handle. SDI-12 devices take a certain length of time to make their measurements. Some devices even require several minutes to finish a measurement; so sending a measurement (0M! or 0C!) request too often will cause data to be lost. Multiple non-concurrent measurements (0M!) are made one at a time, so the time required to make all measurements is cumulative. Concurrent measurements commands (0C!) are issued simultaneously, and collected after the non-concurrent measurements. This means that the total time required to make a measurement is either the sum of all non-concurrent measurement times, or the longest concurrent measurement time, whichever is greatest. If the interval is shorter then this total time data will be lost.
2. **Missed scheduled measurement –** Measurements take some time to make, as described in the previous paragraph. If one or more measurements are scheduled to occur while another previously scheduled measurement is still in process, this error will occur. Depending on several factors, Satlink Logger will try to catch up and make the missed measurements after the first measurement is completed. This will only occur, however, if there is enough time before the next time that missed measurement is to be recorded, so two of the same measurements will not be made one after the other. If Satlink Logger cannot catch up, the data will be logged as "Never Recorded".
3. The exact time that measurements are made can be seen as part of the debug information located on the Diagnostic tab.

Q: Satlink Logger is making measurements correctly, but why am I receiving wrong values?

A: Check that the measurement is set up correctly. The quickest way to verify that a measurement is set up properly is to force a measurement. Does the reading come back as expected?

A: There are several different things that could cause Satlink Logger to display the wrong values
1. **Is the Quality Flag for the data marked as Bad?** Check the sensor to make sure it is properly connected and configured. Make sure that the terminal strip is pinching down on the wires and not the insulation. If the sensor is a SDI-12 device, check if the proper command is being sent to the correct address for the sensor in use.
2. **Is the sensor value incorrect?** Check to make sure that the measurements' slope, offset, and for tipping buckets, that the initial tipping bucket count is correct. Also some SDI-12 sensors also have a built-in slope and offset. If this is the case consult the individual sensor's manual for instructions.

Q: The internal/external measurements are fine, but why isn't Satlink Logger transmitting the data?

A: Check your settings.
1. Check the Main tab to ensure that the system is running and transmissions are enabled. If transmissions are enabled, the Main tab should also display the time of the next transmission.

21300 RIDGETOP CIRCLE
(703)406-2800
STERLING, VA 20166
(703)406-2801 FAX
WWW.SUTRON.COM
SALES@SUTRON.COM

2. **Is the Failsafe tripped?** If the message "FAILSAFE TRIPPED", appears on the Main tab, then the unit cannot transmit until the unit is reset. To reset the failsafe either press the Reset button on Satlink Logger's case, or use the Visual Interface and select "Reset Failsafe" on the Main tab.

3. **During the transmission, what does the battery voltage drop to?** The battery voltage must not drop below 10.5V DC. If the voltage does drop below 10.5 volts, either the battery needs to be replaced, or it does not have a good charge.

4. **What is the output power of the transmitter?** It should be 8 watts ± 1 dB for 100/300 baud, 16 watts ± 1dB for 1200 baud. Lower power may cause problems with the signal being received at the satellite. Higher power may cause your signal to "bleed over" into another frequency and overload the transponder, and therefore, is monitored by NESDIS.

5. Make sure the "Include" box on the Measurements tab for each measurement you want to transmit is checked for either/both Scheduled and Random transmissions. So if you have a 15 minute measurement interval and you are transmitting every 4 hours, you would set your "Num vals to Tx" to 16 to transmit all of the collected data for the past 4 hours. If you want to transmit redundant data, you could set your "Num vals to Tx" to 32. All of the collected data for the past 8 hours is then transmitted.

6. **Is the station ID set?** The factory default is FFFFFFFF, which inhibits transmissions. The user must set a valid ID to allow the transmitter to be enabled.

7. **Did you select an invalid channel?** Satlink Logger knows not to transmit on channel 100 at the 100/300 assignment. Never set it to this channel, as transmissions will not occur.

8. **Is the RS232 cable connected?** Check cable for damage, corrosion, etc.

9. **Is the GPS antenna connected?** Check the connections. Check the cable for damage. Using visual interface, try to sync to GPS under the GPS tab.

Q: Why does the transmission contain M's or /// in place of data?

A: Satlink Logger uses "M" in SHEF and "///" in Binary formatting to indicate a missing measurement.

Data is usually missing because the measurements have been made yet. Satlink transmits recently collected data, not logged data. When a Satlink is rebooted, it has no data to transmit. If a transmission is made before all measurements have been made, missing values will be transmitted.

Another cause of missing measurements is the coinciding of transmission and measurement schedules. If a measurement is set to be collected at the same time as Satlink is preparing the transmission data, the **most recent measurement** will be missing. The way to solve this problem is to have the measurement to be made earlier. Setup measurements to be made at least minute before transmissions. This can be easily accomplished by setting the measurement Offset to one minute and checking the 'Relative to Tx' setting on the Measurements tab.

For example, if 6 values are set to be included in a transmission, and only 4 measurements have been made, Satlink Logger will transmit the 4 available values, and missing data indicators for the other two.

Q: Why does Satlink fail the first transmission after bootup?

A: Satlinks equipped with a Trimble GPS module require up to 30 minutes to acquire GPS time synchronization after the first power up in a new location. If a Satlink is scheduled to transmit before the GPS has acquired time, that transmission will fail. However, once Satlink acquires that first lock, all the following transmissions will work as normal.

STATUS AND ERROR MESSAGES

Error Messages – Occasionally Satlink Logger will display an error message as part of the Status panel on the Main tab. Some of these messages will indicate the reason why Satlink failed a transmission. Here is a list of messages and how to deal with them:

1. **Active measurement has zero interval** – Each active measurement's interval must be greater than zero. The interval can be changed on the Measurements tab
2. **Already Transmitting** – A transmission is currently in progress, so the unit cannot be started.
3. **Bad amp temp** – If temperature of the final amplifier is too high, the transmission will be aborted. Waiting several minutes for the amplifier to cool down should permit transmissions to resume.
4. **Bad forward power** – Any failure of the transmitter that would permit too much forward RF power to the antenna will activate a shutdown circuit. The RF power will remain off for the remainder of the message. When the condition no longer exists transmissions will be resumed.
5. **Battery Low** – The voltage level for Satlink Logger cannot fall below 10.5V during a transmission. Check the charge of the battery.
6. **Cannot tune modulator** – Prior to each transmission, the DC offsets are automatically adjusted thereby calibrating the transmitter. In the event that the offsets cannot be adjusted, the transmission will be aborted.
7. **Error syncing clock to GPS** – The GPS signal acquired is too weak to sync the clock with it. Try increasing the "GPS Acquire Time" or repositioning the antenna.
8. **Failsafe not reset** – The failsafe was tripped prior to transmission. Satlink Logger cannot transmit when the failsafe is tripped.
9. **Failsafe tripped** – This error indicates that the failsafe was tripped during a transmission. The failsafe is separate from the main circuit and makes certain that the unit does not break transmission regulations. This can be reset on the front panel of Satlink Logger, or on the Main tab of the Communicator.
10. **Forced measurement in progress** – A user-initiated measurement is already in progress. To cancel the first measurement press "Abort" on the Measurements tab, then continue with the new forced measurement.
11. **Frequency discipline failed** – Satlink Logger failed to discipline it's TCXO.
12. **GPS failed to acquire time** – Satlink could not acquire a GPS signal in the specified time. Try increasing the "GPS Acquire Time" or repositioning the antenna.
13. **Initialization failed** – Internal error. If this error persists try resetting to Factory Defaults.
14. **Internal timing error** – Satlink Logger was unable to finish the preparation of a transmission before the target time. The transmission is aborted.
15. **Invalid channel** – Certain satellite types do not support certain channels. Check your channel and satellite type settings.
16. **Invalid satellite type** – Same as previous.
17. **Loops not locked** – A key component of the transmission failed to occur, thus causing the transmission to abort.
18. **Measurement interval too short** – Setting the measurement interval shorter than the time needed by an SDI-12 device to make a measurement causes this error.
19. **Missed scheduled measurement** – An unfortunate timing conflict has occurred where a measurement was missed due to another measurement being made. Try adjusting the measurement times so that they are measured simultaneously and not one after another.
20. **Modulator not configured** – The factory calibration for the unit has been lost. It must be sent back to Sutron for recalibration.
21. **PIC comm failure** – Internal error. Satlink Logger will take care of this error by itself.
22. **Satellite ID not set –** The factory default is FFFFFFFF, which inhibits transmissions. The user must set a valid ID to allow the transmitter to be enabled.
23. **SDI-12 comm failure** – Satlink Logger has difficulty communicating with the attached SDI-12 device. Check the connection to the device, and the device's configuration.

24. **SDI-12 command empty** – A measurement command must be specified for the active measurement. See Appendix D for more information on SDI-12 commands.
25. **Software failsafe tripped** – Some internal errors may cause the failsafe to trip, such as transmitting within a short time after rebooting. This also prevents Satlink Logger from breaking transmission regulations. This failsafe resets itself.
26. **Time way off** – When the GPS time sync for a transmission reveals a large time discrepancy, the transmission may be aborted. This commonly occurs during the first transmission after boot up.
27. **User aborted Tx** – The user has aborted a transmission, usually by stopping the system before a transmission's preparation is finished.
28. **Out of heap memory** – Indicates errors in the internal workings of the system.
29. **Heap crash** – Indicates errors in the internal workings of the system.
30. **8400 comm failure** – Satlink failed to get data from an 8400 DDR.
31. **Cimel comm failure** – Satlink failed to get data from a CIMEL data logger.
32. **Failed to log-log busy** – Satlink failed to log a measurement because the log was being cleared or downloaded (Satlink will buffer up measurements that need to be logged. Only during an extremely fast measurement schedule will the Satlink fail to log).
33. **Autostart failed-invalid setup** – When Satlink was booted up, it attempted to start but could not due to an invalid setup.
34. **Frequency not disciplined** – Satlink failed to compensate for TCXO frequency drift. This error may be caused by GPS failing to acquire satellites.
35. **PIC Chip dead –** Indicates a fatal hardware error. This is usually accompanied by a "Failsafe Tripped" error. The PIC is responsible for the failsafe operations of the transmitter and Satlink cannot transmit without it.
36. **Loop one not locked (Loop two not checked)** – Hardware failure in the radio hardware. If it persists, Satlink needs to be sent back to the factory.
37. **Loop two not locked (Loop one locked)** - Hardware failure in the radio hardware. If it persists, Satlink needs to be sent back to the factory.
38. **String heap crash –** Internal software error that will cause Satlink to reset itself using the watchdog. Satlink should be able to recover after it reboots and continue running.
39. **Automatic gain control failed** – Satlink 2 is having trouble outputting the proper RF power. Could be caused by a weak power supply, a bad load on the RF connector (bad antenna), or hardware failure.
40. **Runaway code** – Unexpected software failure. Satlink should end up being reset by the watchdog, restart and resume operation.
41. **Weak battery self shutdown** – Satlink tried to transmit, but the power supplied was too weak to sustain transmission. Transmission was aborted part-way.
42. **TCXO out of range** – Satlink's internal oscillator used to create the transmission carrier signal has drifted out of spec. Satlink will need to be sent back to the factory for TCXO replacement.
43. **This Satlink cannot do analog measurements** – Crafty user managed to setup a Satlink Logger that has no analog measurement circuitry to do analog measurements. The analog measurements will fail. In order to do analog measurements, either obtain a Satlink 2 or add Sutron's SDI-12 AnalogPlus module to Satlink.
44. **Internal error** – Includes other potential errors not included in this list.

Status Descriptions – Satlink Logger performs a variety of tasks, which are displayed in the Status panel on the Main tab. The following lists the possible system statuses:
1. **Continuing Random Tx –** A Random transmission, which has been delayed by a higher priority transmission will now begin processing.
2. **Encoding data for Tx –** The encoding is split into two parts, the encoding of the sensor data, and the encoding of the buffer data.
3. **Frequency discipline started/completed –** A part of the transmission is disciplining the TCXO using the ultra-accurate 1Hz signal from the GPS.

4. **GPS satellite acquisition started –** The GPS unit is searching for a signal from the satellites, in order to acquire the time and location information.
5. **GPS time sync started/succeeded –** This occurs periodically while Satlink Logger is running to ensure the accuracy of the GPS time and position. This occurs at boot-up, before each transmission, and after long stretches of time when no sync has been made.
6. **GPS use disabled –** To re-enable the GPS, reset to factory defaults.
7. **Idling –** The unit is waiting until the next command is given.
8. **Locking loops –** Just prior to transmission, Satlink Logger will lock onto the frequency specified for the transmission.
9. **Random Tx preparation started –** Signifies the beginning of a Random transmission.
10. **Random Tx successfully completed –** The Random Transmission process has finished.
11. **Scheduled Tx preparation started –** Marks the beginning of a Scheduled Transmission.
12. **Scheduled Tx successfully completed –** The Scheduled Transmission process is done.
13. **Send to Sutron Tx successfully completed –** A transmission has been successfully sent to Sutron for troubleshooting purposes.
14. **Send to Sutron Tx prep started –** A transmission is being prepared to be sent to Sutron.
15. **System time changed –** This occurs whenever the system clock is adjusted by a substantial amount.
16. **Test Tx preparation started –** A test transmission, used for troubleshooting, is being prepared.
17. **Transmission stopped –** The transmission, whether successful or not, has been completed.
18. **Transmitting –** The desired information is being sent by radio wave to its destination.
19. **Waiting for post-Tx quiet time to pass –** After each transmission there is a set period of time that Satlink Logger cannot transmit due to radio transmission regulations.
20. **Waiting for TCXO warmup –** The TXCO needs a bit of time before it provides a stable signal.
21. **Waiting for Tx time –** This state is for when Satlink Logger is waiting for a specific time to execute one of its commands during a Scheduled Transmission.
22. **GPS satellite acquisition started –** Satlink powered the GPS module to allow it to acquire satellite signal.

SELF TESTS

A built-in self test capability has been designed to allow a certain level of debugging at the depot level. These self tests are performed on a transmitter in a stand-alone mode. If the unit were a Sutron 8210/Satlink Logger combination, Satlink Logger would be disconnected from the ribbon cable in the 8210 and connected directly to a PC.

The following tests are designed to assist in the trouble shooting of problems that may indicate a hardware failure of some type.

There are two ways to start the self-test. One way is to simply click the "Self Test" button on the diagnostic tab of the Communicator program. The other way involves using a terminal program, and is described in this section.

Launch a terminal program such as HyperTerminal. Connect a serial cable from Satlink Logger to the PC. Open up the appropriate port with the terminal program. Set it to 9600 Baud, 8 data bits, no parity, one stop bit, and no flow control.

At startup, press ESC to display the bootloader self-test menu. The following is a sample output when the Memory Tests and Chip Tests are enabled.

When the Memory or Chip test is enabled, an EEROM bit is set that retains the enabling of the test(s). Therefore, subsequent re-power sequences to Satlink Logger will always run those tests previously enabled. Once debugging a unit is accomplished, go back and disable these tests.

It is possible to upgrade Satlink using the bootloader. If you are having trouble upgrading Satlink via the Communicator program, try using the bootloader's menu.

> # *Warning…*
> *If you enable a test, it will remain enabled and the test will run each time the unit is powered up. Remember to disable the test yourself after enabling and running it. If this is not done, characters will be sent over the serial port causing problems with the communications to the logger.*

```
(In the following menu, pressing any wrong key disables the operation.
Timing-out has no effect)
Press [m] to enable Memory test        09 Key pressed : m
Press [c] to enable Chip test          07 Key pressed : c
Press [b] to enable Bootloader upgrade 08 Key pressed :
Press [a] to enable Application upgrade 05 Key pressed :

SDI-12 test passed

Testing Data Bus To PSD4135G2..............OK

Testing Data Bus To SRAM...................OK

Testing Address Bus........................OK

Finding Number of Data Banks Available.....
    32 banks starting from page number 0x00
    RAM area(4K page) at 0x14 is mirrored/appears from 0x4000
    RAM area(4K page) at 0x15 is mirrored/appears from 0x5000
    RAM area(4K page) at 0x16 is mirrored/appears from 0x6000

Testing Micro RAM..............................OK

Testing Data Bus for byte and word access in SRAM area..OK
```

```
Testing Data Bus for byte and word access in PSD area...OK

Testing PSD4135 RAM from 0x2000 to 0x3fff in unbanked space....OK
Testing SRAM from 0x4000 to 0x4fff in unbanked space....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x00....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x01....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x02....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x03....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x04....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x05....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x06....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x07....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x08....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x09....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x0a....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x0b....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x0c....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x0d....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x0e....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x0f....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x10....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x11....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x12....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x13....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x17....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x18....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x19....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x1a....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x1b....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x1c....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x1d....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x1e....OK
Testing SRAM from 0x7000 to 0x7fff on DataPage 0x1f....OK

Reading PSD4135 Memory information........
  Boot Flash: 32 K Bytes
  Main Flash: 512 K Bytes
  SRAM       : 8 K Bytes

Turning ON switched 12volts,hence green LED..
   Battery voltage Measured = 11.53 Volts.....OK
   Testing Modulator register # 0x01...OK
   Testing Modulator register # 0x02...OK
   Testing Modulator register # 0x03...OK
   Testing Modulator register # 0x04...OK
   Testing Modulator register # 0x05...OK
   Testing Modulator register # 0x06...OK
   Testing Modulator register # 0x07...OK
   Testing Modulator register # 0x0a...OK
   Testing Modulator register # 0x0c...OK
   Testing Modulator register # 0x0d...OK
   Testing for Symbol rate:  100, Symbol Rate Measured: 100.......OK
   Testing for Symbol rate:  300, Symbol Rate Measured: 300.......OK
   Testing for Symbol rate: 1200, Symbol Rate Measured: 1200.......OK
Turning OFF switched 12volts, hence green LED

Testing DS1306 Real Time Clock........
   Testing if DS1306 RTC is ticking....OK
   This verifies SPI communication also.
   Testing DS1306 RTC Alarm 0.........OK
```

```
     Testing DS1306 RTC Alarm 1..........OK

Searching GPS module...................Connected on SCI-2 port
     $Version BOOT 1
     $Version 1.3.4M00283LD02

END OF POWER-ON SELF-TEST
```

Appendices

APPENDIX A: OPERATION WITH SUTRON 8210

This is the addendum to the 8210 manual for version 6.1. It provides user information regarding the added features to the 8210 logger to properly set up and control Sutron's Satlink Logger transmitter. It explains the added features only. See the 8210 operators manual chapter 4-21 for further GOES setup information.

Summary of Features/Changes

The 8210-SL14-1 has been designed to operate nearly identically to the 8210-5014-1.   the following is a summary of the features of the 8210-SL14-1and changes you will see from older versions.

1. The 8210-SL14-1 runs Version 6.1 or later of the operating system. This version supports the new Satlink Logger transmitter as well as all the other communications modes for the 8210. The only functions not in 6.1 that are in 4.A are some of the SSP monitoring functions.
2. The system supports scheduled and random transmissions at rates of 100, 300 and 1200 BPS. The selection of the baud rate is done using a simple menu selection.
3. Satlink Logger's transmitter has a built-in GPS receiver to receive time. The 8210 will synchronize its clock to Satlink Logger before each transmission. You should never need to set the time again on an 8210-SL14. Satlink Logger syncs its time to GPS periodically, before each transmission, and when power is first applied.
4. The 8210 can read in setups from units running version 4.X. If you read in an older setup, you will still need to select the GOES baud rate for the transmission in the GOES Setup menu.
5. Important: Even though version 6.1 is compatible with 4.X setups, you should set up each new configuration on the bench before deploying it in the field.
6. Satlink Logger works independently of the 8210 for its timed transmissions. When recording is turned ON, the 8210 sends to Satlink Logger the desired schedule and transmitter settings. About 30 seconds before a timed transmission, the 8210 will synchronize its clock to Satlink Logger, format the data and send it to Satlink Logger. At the required transmission time, Satlink Logger sends the data. If for some reason Satlink Logger does not get data from the 8210, Satlink Logger will still go ahead and transmit. The message will be "Data Buffer Empty".
7. Satlink Logger works a bit differently for the random transmissions. Random transmissions are initiated by the 8210 based on the settings for RN Rate and RA Rate. When the 8210 wants to send a random transmission it again syncs its clock to Satlink Logger, then formats the data and sends it to Satlink Logger with a command to transmit randomly. Satlink Logger will then transmit the data, usually within a 2 minute window.
8. If the 8210 cannot communicate with Satlink Logger, the message "NOCOM "will be displayed for the recording status. Usually this means that the cable connecting Satlink Logger to the 8210 is not connected. A similar NOCOM message will be displayed in the Inspect System/Display Status screen.
9. The Inspect System/Display status screen has a few changes. The display now reports Satlink Logger good and bad transmission counts. That is because Satlink Logger keeps its own counts of transmissions. The time of last transmission is now the time that the 8210 formatted its data for transmission. As explained above, this can be 30 seconds before the time of the timed transmission.
10. The 8210 supports the "Send Timed" and "Send Random" test transmissions. These transmissions should be done only into a dummy load, and not over the satellite. When you select either of these test transmissions, the 8210 will send the command to Satlink Logger. Satlink Logger will then go through its pre-transmission sequence to acquire time, frequency and then transmit. The actual transmission may not happen until up to 2 minutes from when the test transmission was started.
11. The transmission formats from the 8210-SL14-1 are supposed to be identical to the transmission formats of the 8210-5014-1,however, there were some changes made to the formatting routines, so be sure and bench test a unit before going to the field to install it.

The following sections give some details to the operation of the 8210-SL14-1.

Hardware Interface Requirements

Any 8210 logger is capable of interfacing with Satlink Logger using a special cable (Sutron part 6461-1230-1). This cable is installed with one end having a 30-pin ribbon connector to plug into SLOT1 on the 8210 circuit board. The other end of the cable assembly has a small circuit board with a DB9 connector. When Satlink Logger is installed inside an 8210, this DB9 connects directly to Satlink Logger's COM connector. When Satlink Logger is installed outside the 8210, this DB9 is installed at the bottom of the enclosure so an external cable can be attached. The signal levels of the DB9 are standard RS-232 wired for DTE.
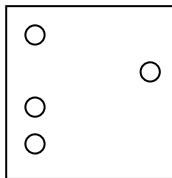
Connecting the 8210 to Satlink Logger

Once the 8210 is connected to Satlink Logger, and Satlink Logger is connected to suitable GOES and GPS antennas, apply power to the units.

GPS Time Synchronization

Satlink Logger automatically synchronizes its clock to GPS before each transmission. This allows the transmitter to transmit at the exact time needed and on the exact frequency. The 8210 will also synchronize its clock to Satlink Logger before each transmission. This allows the 8210 clock to remain accurate over long periods.

8210 Switch Settings

All 8210 loggers use SLOT1 to communicate with Satlink Logger. This is not changed from previous generation GOES setups. You may use SLOT2 for other communications as long as Satlink Logger is not installed inside the 8210. The following switch settings for S1 will correctly configure slot1 for GOES and slot2 for nothing.

As an example, using TS8210, the 8210A should display to following sign-on message:

SUTRON Model 8210A G60
Data Recorder Software

```
N - Unit Name
D - Set Date          BILBO
T - Set Time          06/24/2001
R - Recording Status  22:13:43
C - Clear Alarm       ON&TX
V - View Sensor Data  NORMAL
S - System Setup Options
U - Upload/Download Data
E - EEROM Setup Options
P - Protocol Setup Options
M - Modem Setup Options
G - GOES Radio Setup
I - Inspect System
A - Application Menu
X - Exit
Choose:
```

TS8210 V1.6 F1=EXIT F2=SETUP F3=XYMODEM F6=Clock F10=RESET (C)1996 Sutron Corp.

SATLINK 2 LOGGER AND TRANSMITTER OPERATIONS & MAINTENANCE MANUAL

8210 Software Requirements

A new version of the 8210/8210A operating system is needed for the unit to communicate with Satlink Logger. Operating system software version 61 or later of Sutron part number 8200-1079 is required. Contact customer service at 703-406-2800 to obtain the software.

When requesting the software, be sure to note which version of the 8210 motherboard is used. The versions of the operating system software are not the same for the revision A (8210 256K flash) or revision C (8210A 512K flash) motherboards. The software can be updated through the PCMCIA slot. Update the software in the 8210 following the procedure provided with the software update.

GOES Radio Setup Menu

The Goes Radio Setup Menu has two new options. The first is used to set the transmit rate (100, 300, or 1200 baud). The other is used to clear Satlink Logger's transmission counters.

GOES Radio Setup Menu Screen

- Option 7 allows the transmit modulation rate to be selected from either 1200, 300 or the standard 100 baud rates. Pressing 7 repeatedly will toggle between the various rates.
  Changing this value will turn recording OFF because Satlink Logger is required to obtain a new setup from the 8210 to recognize this change. Assuming no other changes, such as scheduled channel value required for different baud rates, turn recording back ON by returning to the main menu by typing <ESCAPE> and typing "R" to restart the GOES transmit process.

- Option 8 is used to clear the running GOES transmit counters within both the 8210 and Satlink Logger transmitter. Clearing these counters will not affect recording status.

All other menu entries are unchanged from previous versions of the 8210 operating system.

Inspect System Status Screen

The GOES transmit counter field was enhanced to show both the number of attempted GOES transmissions sent to Satlink Logger and the corresponding bad GOES transmissions. The following status screen shows a system that has difficulty transmitting information over the assigned GOES channel. This shows the 8210 attempting five transmissions with four reported successful and one reported bad shown in this screen.

```
TS8210                                                    _ □ ✕

Auto  ▼   ▣ ▤ ▥  ✦  ▦▨  A

SYSTEM STATUS
   No System Errors
   Resets: 53
   ROM CheckSum: 57860
   EEROM CheckSum: 16622
   LOG Size: 121K
   Basic Status: 1K - Stopped, No Errors
   Recording Status: Waiting
   Goes Status: Wait Timed, Normal, Next 20:32:00  Last 20:22:00
   Battery Status: Min= 12.83, Max= 13.22
   8210 Attempted Goes Tx: 5
   HDRT Reported GOOD   Tx: 4
   HDRT Reported BAD    Tx: 1
   Ram Card: Inserted, Size 1024KB, Left 640KB
Press SPACE to repeat or ESC to exit:




TS8210 V1.6  F1=EXIT F2=SETUP F3=XYMODEM F6=Clock F10=RESET (C)1996 Sutron Corp.
```

Front Panel GOES Radio Setup Changes

Two new menu selections were added to the front panel.

- GoesRate   <value>

  This entry allows the operator to change the GOES transmit modulation rate between either 1200, 300 or 100 baud rates. Pressing the <SET> key repeatedly will toggle between the various rates.
  Changing this value will turn recording OFF because Satlink Logger is required to obtain a new setup from the 8210 to recognize this change. Assuming no other changes, such as scheduled channel value required for different baud rates, turn recording back ON by using the arrows to move to the recording menu entry and pressing <SET> to restart the GOES transmit process.

- Send Clock

  This entry allows the operator to transfer the 8210 time setting to Satlink Logger. Make sure GMT time is set in the 8210 before transferring the time. Press the <SET> key to do this.

Front Panel Inspect System Menu Changes

Within the inspect system menu, the GOES RADIO TEST menu will only perform the following actions.

- Send test data over the scheduled channel

  This option will send test data over the channel assigned for scheduled transmissions.

- Send test data over the random channel

  This option will send test data over the channel assigned for random transmissions.

  Notes/Issues:
  1. When the 8210 displays the recording status, it will send a request of the status to Satlink Logger. If the 8210 does not get a reply, "NOCOM" will be displayed.
  2. Note that the 8210 will wake up 30 seconds before the time of a transmission in order to format the data and send it to Satlink Logger.
  3. GOES setup errors means one of the following: no sensor in group being transmitted, less than 4 minutes between transmissions.
  4. In the status message, time of last transmission is the time that the 8210 formatted the data (29 to 30 seconds before the actual transmission was made).

APPENDIX B: OPERATION WITH SUTRON XPERT

The operation of Satlink Logger with an Xpert is fully documented in the Xpert Operation and Maintenance Manual (part number 8800-1127). This section gives a brief overview of the functions:

Control Panel

Satlink Logger's branch in the control panel is used to manage the details of the setup for both Scheduled and Random transmissions. The main branch sets the Satellite ID, Comm port (Xpert connection to Satlink Logger) and whether or not the Xpert will alter settings in Satlink Logger.

The Scheduled and Random branches in the control panel allow the setup of Scheduled and Random transmissions. This includes the setup of the channel, format, transmission type, transmission time, transmission intervals and so forth.

The Scheduled Test and Random Test branches in the control panel allow you to view the current message that would be sent by Satlink Logger, make test transmissions, and view the transmitter status.

Setup

Telemetry blocks are used in the setup in order to include data in Scheduled and Random transmissions as well as trigger random transmissions. When you want a particular value included in a scheduled transmission, you must connect the value to a Scheduled block. The properties of this block allow you to specify data used by the formatter in order to include the data in the transmission. Data are included in random transmissions by connecting the value to a Random block. Finally, you control the values that trigger random transmissions by connecting the value to a Random Group block.   The properties of this block set the type of checks to run on the data in order to generate random transmissions including hi alarm, low alarm, rate of change alarm and the corresponding levels and limits.

The details of these blocks and the control panel properties are found in the Xpert Operator and Maintenance Manual.

APPENDIX D: MORE ABOUT SDI-12

Overview

SDI-12 is a standard for interfacing data recorders with microprocessor based sensors. SDI-12 stands for serial data interface at 1200 baud. SDI-12 is intended for applications with the following requirements:
- Battery powered operation with minimal current drain
- Low system cost
- Use of a single data recorder with multiple sensors on one cable
- Up to 200 feet of cable between the sensor and a data recorder

SDI-12 has the following advantages:
- It defines a standard way for a data recorder and sensor to communicate.
- Unique and complex self-calibration algorithms can be done in the sensor itself.
- Sensors can be interchanged without reprogramming the data recorder with calibration or other information.
- Power is supplied to sensors through the interface.
- The use of a standard serial interface eliminates significant complexity in the design of the data recorder.
- Low cost, small sensors can be designed with SDI-12 compatibility.
- SDI-12 data recorders interface with a variety of sensors.
- SDI-12 sensors interface with a variety of data recorders.
- Personnel trained in SDI-12 will have skills to work with a variety of SDI-12 data recorders and sensors.

SDI-12 is used in water resource research and management, industry, government, and agriculture. For example, the U.S. Geological Survey uses over 4000 SDI-12 sensors in its data collection networks. SDI-12 sensors are available that measure the following:

- bridge scour
- conductivity
- dissolved oxygen
- distance
- groundwater level
- petroleum hydrocarbons in water
- pH
- pressure
- redox (ORP)
- tank level
- temperature
- tide and sea state
- turbidity
- water velocity
- weight of snow and ice on a snow pillow
- wind speed and direction

Sutron also offers general purpose interfaces for making analog and digital measurements via SDI-12.

For more information on SDI-12, go to www.sdi-12.org.

Wiring

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: data, ground, and +12V. The ground conductor of the SDI 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. The maximum current used on the +12V line should not exceed 2 amps at any time.

Connector

The connector type is not part of the SDI specification. On Satlink Logger, the connector is labeled: G (Ground), + (12V) and D (Data). Multiple sensors can be connected to these connections.

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 Satlink Logger you must set each sensor to a unique address. This is normally done by setting dipswitches on the sensor or by software commands. Failure to set unique addresses for each sensor will result in failure of the communications interface (i.e. no data logged). Consult the sensor manufacturers data for information on your particular sensor(s).

Note that Satlink Logger Communicator provides a means to set up the SDI-12 sensors via its Measurements tab, "Send SDI-12 Command".

Useful SDI commands

Resetting the address by software (some sensors) is normally done by sending the aAb! command. (a A b !, where a is the current address of the sensor you want to change and b is the address you want to change to, e.g. 0A5! changes the address of sensor 0 to address 5.)

Another useful SDI-12 command is the aI! (where a is the address of the sensor, e.g. 3I! for sensor at address 3) command. 4I! will return an identification string from the sensor at address 4 which includes the SDI version number, vendor's name, sensor model number, sensor version number, and serial number. This is a quick way to see if the sensor is responding properly.

A way to verify data collection (manual data collection) is to issue the aM! command. For example 7M! would collect data from the sensor at address 7. The sensor will respond with a 5-digit code -- the first digit is the address, the next 3 digits are the required time for measurement in seconds, and the last digit is the number of data values returned. Wait for the number of seconds. Then issue the aD0! (address, D, zero, !) the sensor should respond with one or more data values. You may issue further aD1! … aDn! till you get all of the data.

If the SDI sensor is version 1.3 (which can be found out by sending the ?I! command; the version is returned as the second and third characters of the response), then make sure to use the CRC measurement commands. These commands work just like normal measurement commands, except that they use an error checking mechanism that **minimizes errors**. So, instead of 0M!, use 0MC!. Instead of 0M1!, use 0MC1!. This will ensure reliable SDI communication.

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APPENDIX E: DATA TRANSMISSION FORMATS

Satlink Logger can be configured to transmit the data in several different formats:
1) Random Transmission Pseudobinary format
2) Scheduled Transmission Pseudobinary
3) Scheduled Transmission SHEF format
4) Scheduled Transmission SHEFFIX format

RANDOM TRANSMISSION PSEUDOBINARY DATA FORMAT

This format is used when Satlink Logger makes a random or alarm transmission. The format of the transmission data is:

        <GROUP-ID> <OFFSET>
        <MEASUREMENT1-DATA(1)> <MEASUREMENT1-DATA(2)> ... <MEASUREMENT1-DATA(N)>
        <MEASUREMENT2-DATA(1)> <MEASUREMENT2-DATA(2)> ... <MEASUREMENT2-DATA(N)>
        <MEASUREMENT3-DATA(1)> <MEASUREMENT3-DATA(2)> ... <MEASUREMENT3-DATA(N)>
        <EXTERNAL DATA>
        <COUNTER>
        <BATTLOAD>
        <LAT/LONG>

where:

GROUP ID   The GROUP ID is a "2" for all random transmissions.

OFFSET   OFFSET is a 1-byte binary encoded number indicating the number of
            minutes ago the most recent data was recorded. Note that the number
            of minutes is calculated about 15 seconds prior to transmission.

MEASURE   Measurement data collected by Satlink Logger: this data contains only
MENT   those measurements set up to be included in the random transmission.
DATA   The data values are 3 byte binary encoded signed numbers allowing a
            range of: -131072 to +131071. The actual 6-bit binary encoded format
            is described later. The value transmitted is taken directly from the 32
            value measurement buffer in Satlink Logger. The value transmitted will
            be value * 10^RightDigits. The string "///" will be sent if the data was
            never measured or was erased.

            The number of values sent for each measurement is set separately for
            each measurement in the Random Transmissions, Num values to Tx
            field. Note that this is different from the 8210 where the num values to
            Tx was the same for each sensor. As a result, Satlink Logger sends all
            the required values for one sensor (most recent first) before proceeding
            to the next measurement. In the 8210, values were interleaved.

EXTERNAL   This is data given to Satlink Logger by a device through the RS-232
DATA   port. This data is untouched by Satlink Logger. It gets transmitted in
            the same way it was received.

LAT/LONG   This is an optional field; it will be included only if "Append Lat/Long" is selected for random transmissions.

LAT/LONG can be decoded into D:M:S format by converting the binary values to decimal and applying the following formula:

Degrees latitude = 64 * (1st-byte AND 63) + (2nd-Byte AND 63) − 180
Minutes latitude = 3rd-byte AND 63
Seconds latitude = 4th-byte AND 63
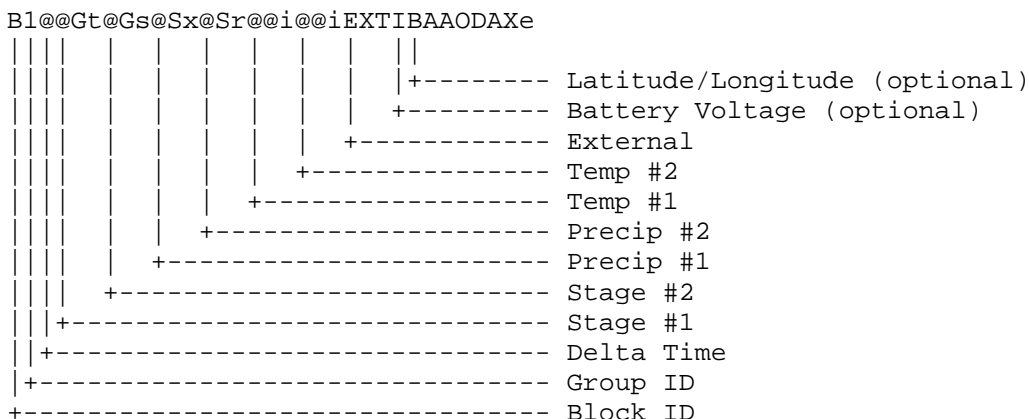Degrees longitude = 64 * (5th -byte AND 63) + (6th -Byte AND 63) − 180
Minutes longitude = 7th-byte AND 63
Seconds longitude = 8th-byte AND 63

For example BAAODAXe would be decoded as Lat N 39o 1' 15.79" Long W 77o 24' 37.19"

COUNTER   COUNTER is a 2 byte binary encoded number which indicates the transmission number and increments after every transmission. The number will be between 0 and 4095.

BATTLOAD   BATTLOAD is a 1 byte binary encoded number representing the battery voltage of Satlink Logger under load during the last transmission. If the battery reading is zero, then that is the first transmission since bootup. 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:

   Here is a message with three active measurements; each one is set to include two readings. The random buffer contains the string "EXT". This string was given by an external device through the RS-232 port.

```
2@@Gt@Gs@Sx@Sr@@i@@iEXTBAAODAXe@GI
|||   |   |   |   |   |   |   |   |       | |
|||   |   |   |   |   |   |   |   |       | +- Battery Voltage
|||   |   |   |   |   |   |   |   |       +--- Random Counter
|||   |   |   |   |   |   |   |   +----------- Latitude/Longitude (optional)
|||   |   |   |   |   |   |   +-------------- External Data
|||   |   |   |   |   |   +---------------- Temp #2
|||   |   |   |   |   +------------------- Temp #1
|||   |   |   |   +---------------------- Precip #2
|||   |   |   +-------------------------- Precip #1
|||   |   +----------------------------- Stage #2
|||   +-------------------------------- Stage #1
||+--------------------------------- Delta Time
|+-------------------------------- Group ID = 2
+------------------------------- Group ID = 2
```

SCHEDULED PSEUDOBINARY DATA FORMAT

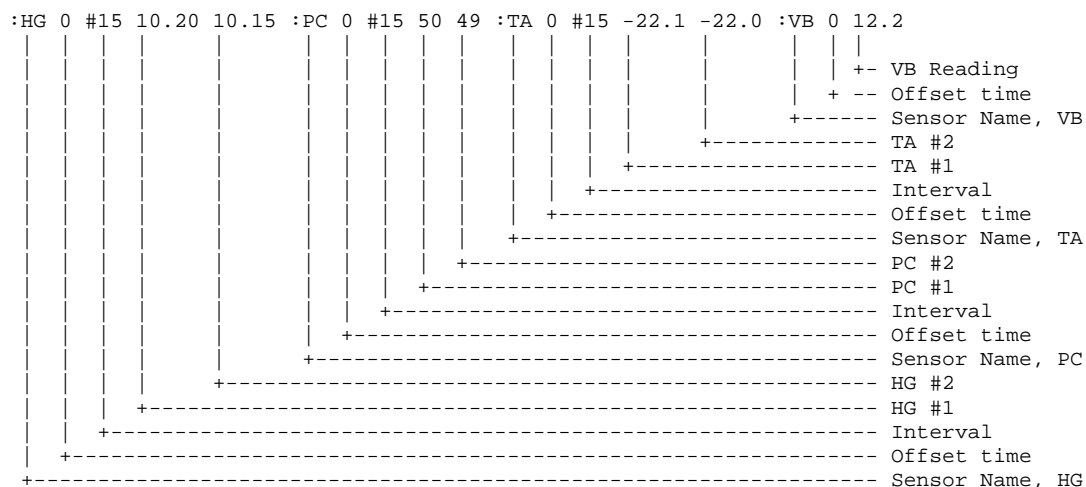This format is used when Satlink Logger makes a scheduled transmission and the format has been set to PSEUDOBINARY. The format of the transmission data is identical to the Random Pseudobinary format except that the message starts with a BLOCK-IDENTIFIER B, the GROUP-ID is a 1, and there is no count. The transmission includes data from any measurement that has the "Scheduled Transmissions: Include" box checked. The number of values to send in each message is set by the num values to Tx field.

<GROUP-ID> <OFFSET>
<MEASUREMENT1-DATA(1)> <MEASUREMENT1-DATA(2)> ... <MEASUREMENT1-DATA(N)>
<MEASUREMENT2-DATA(1)> <MEASUREMENT2-DATA(2)> ... <MEASUREMENT2-DATA(N)>
<MEASUREMENT3-DATA(1)> <MEASUREMENT3-DATA(2)> ... <MEASUREMENT3-DATA(N)>
<EXTERNAL DATA>
<BATTLOAD>
<LAT/LONG>

BLOCK IDENTIFIER	BLOCK-IDENTIFIER is always sent as "B" to indicate the start of a binary data group.
GROUP ID	GROUP-ID is always sent as "1" to indicate the scheduled group.
OFFSET	Each record is prefixed with an <OFFSET>, which is a 1 byte binary encoded number indicating the number of minutes ago the most recent data was recorded. Note that the number of minutes is calculated about 15 seconds prior to transmission.
MEASUREMENT DATA	Measurement data collected by Satlink Logger: This data contains only those measurements set up to be included in the scheduled transmission. The data values are 3 byte binary encoded signed numbers allowing a range of: -131072 to +131071. The actual 6-bit binary encoded format is described later. The value transmitted is taken directly from the 32 value measurement buffer in Satlink Logger. The value transmitted will be value * $10^{RightDigits}$. The string "///" will be sent if the data was never measured or was erased.
	The number of values sent for each measurement is set separately for each measurement in the Scheduled Transmissions, Num values to Tx field. Note that this is different from the 8210 where the num values to Tx was the same for each sensor. As a result, Satlink Logger sends all the required values for one sensor (most recent first) before proceeding to the next measurement. In the 8210, values were interleaved.
EXTERNAL DATA	This is data given to Satlink Logger by a device through the RS-232 port. This data is untouched by Satlink Logger. It gets transmitted in the same way it was received.
BATTLOAD	BATTLOAD is appended if the "Append Quality" box is checked on the Scheduled Tx tab. This is a 1 byte binary encoded number representing the battery voltage of Satlink Logger under load during the last transmission. If the battery reading is zero, then that is the first transmission since bootup. 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.

LAT/LONG   This is an optional field; it will be included only if "Append Lat/Long" is selected for random transmissions.

LAT/LONG can be decoded into D:M:S format by converting the binary values to decimal and applying the following formula:

Degrees latitude = 64 * (1st-byte AND 63) + (2nd-Byte AND 63) $-$ 180
Minutes latitude = 3rd-byte AND 63
Seconds latitude = 4th-byte AND 63
Degrees longitude = 64 * (5th-byte AND 63) + (6th-Byte AND 63) $-$ 180
Minutes longitude = 7th-byte AND 63
Seconds longitude = 8th-byte AND 63

For example BAAODAXe would be decoded as Lat N 39o 1' 15.79" Long W 77o 24' 37.19"

EXAMPLE:

Here is a message with three active measurements; each one is set to include two readings. The scheduled buffer contains the string "EXT". This string was given by an external device through the RS-232 port.

```
B1@@Gt@Gs@Sx@Sr@@i@@iEXTIBAAODAXe
||||   |   |   |   |   |   |   ||
||||   |   |   |   |   |   |   |+-------- Latitude/Longitude (optional)
||||   |   |   |   |   |   |    +--------- Battery Voltage (optional)
||||   |   |   |   |   |   +------------ External
||||   |   |   |   |   +-------------- Temp #2
||||   |   |   |   +----------------- Temp #1
||||   |   |   +-------------------- Precip #2
||||   |   +----------------------- Precip #1
||||   +------------------------- Stage #2
|||+---------------------------- Stage #1
||+----------------------------- Delta Time
|+------------------------------ Group ID
+------------------------------- Block ID
```

SCHEDULED SHEF DATA FORMAT

This format is used when Satlink Logger makes a scheduled transmission and the format has been set to SHEF. The format of the transmission data is:

":" <LABEL1> <OFFSET> "#"<INTERVAL> <DATA1> <DATA1> ... <DATA1)>
":" <LABEL2> <OFFSET> "#"<INTERVAL> <DATA2> <DATA2> ... <DATA2>   ...
":" <LABEL(N)> <OFFSET> "#"<INTERVAL> <DATA(N)> <DATA(N)> ... <DATA(N)>
":" <EXTERNAL DATA>
":BATTLOAD 0 " <BATTLOAD>
<LAT/LONG>

LABEL	This is the Label entered in Satlink Logger in the Measurements:Settings:Label field. The Label can be a SHEF two character parameter code such as HF for gauge height or PC for cumulative precipitation or it can be any string you enter. Refer to http://noaasis.noaa.gov/DCS/htmfiles/schefcodes.html for a list of SHEF codes commonly used.
OFFSET	Each record is prefixed with an <OFFSET>, which is an ASCII number indicating the number of minutes ago the most recent data was recorded. Note that the number of minutes is calculated about 15 seconds prior to transmission.
INTERVAL	INTERVAL indicates how often the measurement was made.
MESURE- MENT DATA	This is data collected by Satlink Logger through measurements. Only those measurements with the Scheduled Transmissions Include box checked are included in the transmission. Like the binary formats, the SHEF format groups all the related data from one measurement. The data is transmitted in ASCII with sign and decimal point (if needed). If a data value has not yet been recorded (or has been erased) the letter "M" for missing data will be sent. The most recent data is always sent first. The number of values sent for each measurement is set on a measurement by measurement basis.
EXTERNAL- DATA	This is data given to Satlink Logger by a device through the RS-232 port. This data is untouched by Satlink Logger. It gets transmitted in the same way it was received.
BATTLOAD	BATTLOAD is appended if the "Append Quality" box is checked on the Scheduled Tx tab. <BATTLOAD> represents the battery voltage of Satlink Logger under load during the last transmission. If the battery reading is zero, then that is the first transmission since bootup.
LAT/LONG	This is an optional field; it will be included only if "Append Lat/Long" is selected for random transmissions. The Lat/Long information will be user readable. For example, N39O1'18.48"W77O24'36.91" means a latitude of North 39 degrees, 1 minute, 18.48 seconds and longitude of W 77 degrees, 24 minutes, 36.91 seconds.

EXAMPLE:

Here is a message with three active measurements; each one is set to include two readings. The random
buffer contains the string "EXT". This string was given by an external device through the RS232 port.
Notice how much longer this message is compared to the earlier binary examples.

```
:HG 0 #15 10.20 10.15 :PC 0 #15 50 49 :TA 0 #15 -22.1 -22.0 :VB 0 12.2
 | | | |   |     |     | | |  |  |   | | |   |     |     | | |  |
 | | | |   |     |     | | |  |  |   | | |   |     |     | | |  | +- VB Reading
 | | | |   |     |     | | |  |  |   | | |   |     |     | | |  + -- Offset time
 | | | |   |     |     | | |  |  |   | | |   |     |     +------ Sensor Name, VB
 | | | |   |     |     | | |  |  |   | | |   |     +------------ TA #2
 | | | |   |     |     | | |  |  |   | | |   +------------------ TA #1
 | | | |   |     |     | | |  |  |   | | +-------------------- Interval
 | | | |   |     |     | | |  |  |   | +------------------------ Offset time
 | | | |   |     |     | | |  |  |   +-------------------------- Sensor Name, TA
 | | | |   |     |     | | |  |  +----------------------------- PC #2
 | | | |   |     |     | | |  +-------------------------------- PC #1
 | | | |   |     |     | | +--------------------------------- Interval
 | | | |   |     |     | +--------------------------------------- Offset time
 | | | |   |     |     +--------------------------------------- Sensor Name, PC
 | | | |   +--------------------------------------------------- HG #2
 | | | +----------------------------------------------------- HG #1
 | | +--------------------------------------------------------- Interval
 | +----------------------------------------------------------- Offset time
 +------------------------------------------------------------- Sensor Name, HG
```

Note: the names HG, PC, TA are the measurement labels assigned by the person setting up
Satlink Logger. These did not get transmitted.

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

ASCII COLUMN FORMAT

The ASCII Column format is another means of encoding transmission data. A message formatted with this method would look like this:

    <CRLF>
    Meas1_Data(1) Meas2_Data(1) ... MeasN_Data(1)<CRLF>
    Meas1_Data(2) Meas2_Data(2) ... MeasN_Data(2)<CRLF>
    Meas1_Data(n) Meas2_Data(n) ... MeasN_Data(n)<CRLF>

- <CRLF> is a carriage return, line feed
- Meas1_Data()..MeasN_Data are the data from the active measurements included in the transmission.
- All the data on one line are for the same time. A space separates the values. The newest data is sent first.
- (n) is the number of values included in the transmission as set by the user.
- The format for any value is ASCII with the right digits set by the user.
- No decimal point is shown if the value is zero.
- Add a minus sign in front of the value if the value is negative.
- There are no leading zeroes.
- If the value is missing, two forward slashes are transmitted instead //.

A typical message will appear as follows:

    41.79 60.99 12.99 12.43 .20 8.08 7.1 195.2
    41.79 60.99 12.99 12.43 1.20 8.08 7.1 195.2
    41.79 60.99 12.99 12.43 -2.20 8.08 7.1 195.2

Normally the DCP will be set up so all the sensors are collected at uniform times. If this is not the case, the formatter will still work but will have varying amounts of data on each line (each time) based on whatever sensors are collected at each time. This will produce confusing results if the additional sensors are collected at an interval of the other sensors. The results should be OK if the additional sensors are collected at a time separate time.

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ASCII SENSOR FORMATTING

This method of formatting uses four digits for each measurement readings. Measurement readings are multiplied by 100 before being transmitted.

    <CRLF>
    IDIDIDID JJJHHMMSS<CRLF>
    Meas1_Data(1) Meas1_Data(2) ... Meas1_Data(n)<CRLF>
    Meas2_Data(1) Meas2_Data(2) ... Meas2_Data(n)<CRLF>
    MeasN_Data(1) MeasN_Data(2) ... MeasN_Data(n)<CRLF>
    optional Battery before transmission<CRLF>
    optional Battery under load<CRLF>

- <CRLF> is a carriage return, line feed
- IDIDIDID is the eight byte hexadecimal satellite ID
- JJJ is a three digit Julian Day, which is the number of days of the year. January 1st is Julian Day one, and February 1st is Julian Day 32. This number is always three digits (0 padded)
- HHMMSS are the hours minutes and seconds. This is the time of the scheduled transmission. It is always 6 bytes (0 padded).
- Meas1_Data()..MeasN_Data are the data from the active measurements included in the transmission.
- Measurement data is always four digits followed by a space (0 padded).
- All values are multiplied by a 100.
- No decimal point is used for measurement data.
- Range of transmitted data is 0 to 9999 (numbers out of range are transmitted as 0000 or 9999). This means that the sensor data should be between 0 and 99.99 before formatting.
- If the user elects to append battery voltage (see page 61), one of the two will be appended:
    - If the transmission satellite is Japan GMS or Meteosat MSG, only one line of battery voltage information will be added. It will take this format: "13.5<CR><LF>" Three digits and a decimal point are always used. It is the battery voltage prior to the transmission.
    - For all other transmission types, two lines of battery voltage information will be added. Both lines take the same format: "12.5<CR><LF>" (three digits of battery voltage and a decimal point). The first line is the battery voltage prior to this transmission. The second line is the battery voltage during the last transmission.

This is an example transmission:

    010570F2 108183053
    0250 0250 0250 0250
    2231 2232 2233 2234
    12.2
    12.1

1. On the first line 010570F2 represents the hexadecimal satellite ID. 108 is the Julian Day (for the year 2005, that is April 18th). 183053 means 18 hours 30 minutes and 53 seconds.
2. The second line (0250 0250 0250 0250) shows four readings of the first sensor. This measurement had four same readings. Before formatting, that reading was 2.50. It was multiplied by 100 and padded with a leading zero.
3. The third line (2231 2232 2233 2234) shows four different readings of the second sensor. That sensor's readings were originally 22.31, 22.32, 22.33, and 22.34 respectively. They were multiplied by 100 and padded with a leading zero.
4. The fourth line (12.2) is the battery reading in Volts prior to transmission.
5. The last line (12.1) is the battery reading in Volts during the last transmission.

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DATA RECEIVED THROUGH DAPS

Once data transmitted by Satlink is retrieved, it will have information added on by the NESDIS satellite receiver system. This information was gathered from the "User Interface Manual (UIM) Version 1.1 for the GOES Data Collection System Automatic Processing System (DAPS)". Here is an example of a message sent by Satlink and received by the DAPS system:

010570F207141162408G40-2NN195EFF00062 SATLINK DATA BUFFER EMPTY Alive TIME 2007/05/21 12:23:54

SATLINK DATA BUFFER EMPTY Alive TIME 2007/05/21 12:23:54 is data sent by Satlink. All the preceding bytes constitute the header added by DAPS. Here is an explanation of the header.
- The first six bytes 010570F2 are the hexadecimal satellite ID. This is the same as the ID that Satlink is setup with. It is sometimes referred to as the address.
- 07 is the year. 07 means 2007.
- 141 is a three digit julian day of the year. January 1st is Julian Day one, and February 1st is Julian Day 32. This number is always three digits (0 padded)
- 162408 is the time of day. 16:24:08. 16 is 4 PM military time, 24 is the number of minutes and 08 the number of seconds.
- G is the Failure Code 1. It can be
  - G - Good message
  - ? - Message received with parity errors
  - W - Message received on wrong channel
  - D - Message received on multiple channels (duplicate)
  - A - Message received with address error(s) (correctable)
  - T - Message received late/early (time error)
  - U - Unexpected message
  - M - Missing message
  - N - PDT entry for this platform is not complete
- 40 is EIRP or received signal strength (implied EIRP, assuming that the pilot is a +47 dBm reference). Signal strength is output as two ASCII digits ranging between 32 and 57 (decimal). The nominal operating range is 44 to 49 dBm.
- -2 is the Frequency Offset. The first byte is an ASCII plus (+) or minus (-) sign, the second byte is an ASCII number zero (0) through nine (9) or the ASCII character "A". The number indicates the amount in increments of 50 Hz. The character "A" represents 500 Hz which is the worst case frequency error that the DAMS units can acquire. The nominal operating range for frequency offset is +250 Hz (+5).
- N is the Modulation Index. It can be
  - N for normal (desired)
  - L for low
  - H for high
- N is the Data Quality. It can be
  - N (Normal, error rate better than 1 X 10-6)
  - F (Fair, error rate between 1 X 10-4 and 1 X 10-6)
  - P (Poor, error rate worse than 1 X 10-4)
- 195 is the transmission channel
- E is the spacecraft. It can be E for east or W for west.
- FF is the uplink carrier status
- 00062 means that 62 bytes of non-header data were received
- There is a space after 62 and before SATLINK. It is the quality flag:

" (quote)	0x22	Clock updated since last TX
(space)	0x20	Clock not updated since last TX
b	0x62	Clock updated, Pseudo Binary
`	0x60	Clock not updated, Pseudo Binary
B	0x42	Clock updated, BINARY
@	0x40	Clock not updated, BINARY

APPENDIX F: VERSION HISTORY

Dated August 2007
Satlink1 5.14 Satlink 2 Version 6.24 and Communicator Version 3.24
> *Bug fixes:*
> - INSAT transmissions were always at the top of the second. Fixed to be anywhere during the second.
> - Random pseudobinary transmission offset byte was always ?.
> - Satlink may cause Sutron Sdi Shaft Encoder rotation to change to clockwise (bug since 6.22 only)

Dated March 2007
Satlink 1 Version 5.12 and Communicator Version 3.23
> *Bug fixes:*
> - Handling incorrect time from the GPS.
> - Communictor would not close if it could not write to the .ini file.

Dated March 2007
Satlink 2 Version 6.22 and Communicator Version 3.22 and Display Version 3.21
> *Enhancements:*
> - Remove measurement cutoff voltage.
> - Enhance time setting via SDI-12.
>
> *Bug fixes:*
> - Handling incorrect time from the GPS.
> - Frequency discipline from the future (GPS malfunction).
> - Advanced settings binary data format and interleaver do not work together.
> - Satlink Display fails to find internal modem.

Dated October 2006
Satlink 2 Version 6.21 and Communicator Version 3.21
> *Enhancements:*
> - Added additional frequency discipline filter.
>
> *Bug fixes:*
> - Satlink could stop measuring (bug in versions 6.15 to 6.20)
> - Multiple concurrent SDI-12 measurements on same sensor were not treated as concurrent.

Dated July 2006
Satlink 2 Version 6.17 and Communicator Version 3.19
> *Enhancements:*
> - Added Tipping Bucket Rate Measurement Type
> - Synchronizes clock with SDI devices such as the Sutron SDR and Sutron CF Bubbler
> - Add FRACT, INT, ABS functions to equation processing
> - Communicator can open .sls file on startup (via drag and drop, command line, or .sls file association)
>
> *Bug fixes:*
> - Local Time offset above 9 hours works properly now
> - Satlink did not acknowledge Cimel after receiving transmission data
> - Analog SW+12V failure (introduced in 6.10)
> - System time was garbled on computers running Windows with the Chinese language
> - Disabling/enabling one equation sometimes disables all equations
> - Communicator did not properly remember entered SDI-12 commands in Send SDI-12 Command window

Dated January 2006
Satlink 2 Version 6.13 and Communicator Version 3.17
Enhancements:
- Minimum and maximum processing added
- Satlink password protection added
- Additional log format added
- Voltage cutoff limits changed. Satlink will not measure if voltage is too low.
- Satlink Temperature measurement type added.
- Identical measurements shared (if the same sensor type is setup in two
- different measurements, only one reading is made and used by both measurements).
- Meteosat MSG maximum transmission length changed from one minute to four minutes.

Bug fixes:
- Satlink used to take responses from any SDI-12 address.
- Fixed rare bug that would cause Satlink log download to fail immediately after it started.
- Checking firmware version from the Scheduled Tx tab could cause Communicator to show SHEF instead of Pseudobinary sensor data formatting.
-

Dated August 2005
Satlink 2 Version 6.10
Enhancements:
- Analog measurements accuracy improved.
- Analog measurements sampling speed improved for 0-5V and ratiometric type readings.
- A new type of analog measurement (bridge) added.
- SDI sampling speed increased by as much as two seconds.

Bug fixes:
- Satlink used to take responses from any SDI-12 address.
- Forcing concurrent SDI-12 measurements did not work.
- Extremely long GOES 1200 messages (with more than 8K of data) could have been scrambled near the end.
- SHEF encoding delta-time was off by 1 minute.
- Forced transmissions with ASCII Sensor format used to have a time of 0.
- Trimble GPS UTC offset fix.

Communicator Version 3.14.02
Enhancements:
- New analog measurement type added: bridge.

Bug fixes:
- Buffer Control Window : Append Data to Satlink's Buffer does not work (bug only in 3.13)

Dated April 2005
Satlink 2 Version 6.09
Enhancements:
- Two new transmission formats for sensor data collected by Satlink: ASCII Column and ASCII Sensor.
- GMS satellite transmission have an additional end of transmission character (an equals sign =)
- ARGOS satellite transmission power adjusted.
- NDBC 40 Watt mode power readings have been corrected (Satlink must be calibrated to read correctly)
- NDBC 40 Watt mode is controlled via switched 12V on the analog sensor connector.
- Satlink will not transmit if the supply voltage is too high.

Bug fixes:
- SDI-12 Communications with certain devices were failing. Satlink's response time was increased.

Communicator Version 3.13.04

Enhancements:
- New transmission sensor format modes added: ASCII Column and ASCII Sensor.
- Unavailable transmission options grayed out based on satellite type and format. This makes it obvious what settings will not have any effect on specific satellite types.
- Calibration of Satlink output power for Sutron personnel improved. INSAT power control removed.

Dated December 2004
Satlink 2 Version 6.08
    Enhancements:
- ARGOS and SCD satellite support
- Feng Yun satellite support
- NDBC 40W mode support
- Improvements to satellite transmission frequency stability.

Communicator Version 3.12.19
    Enhancements:
- Modem dialing improved.
- Satlink supports ARGOS and SCD satellite types.
- NDBC 40W Mode support.
- Support for Satlink display
- Various minor fixes and improvements.

    Bug Fixes:
- Occasional log download failures fixed (bug would manifest with the YModem Progress dialog showing no progress and no log being downloaded).
- CmdListAutoSave.cmd file created only when necessary.
- Two Communicator programs can download logs from two Satlinks at the same time.

Dated September 2004
Satlink 2 Version 6.07
    Enhancements:
- INSAT satellite support added for Satlink2.
- Modem and Bluetooth support added by loosening the timing restraints on communication.
- Satlink can now keep local rather than UTC time through the local time offset control.
- Measurements now have default labels.
- Support for Satlink Display (allows for measurement calibration while Satlink is running).

    Bug Fixes:
- Tipping bucket input no longer makes superfluous counts on a noisy input. This only affects tipping buckets connected directly to Satlink, not those connected to 8210, 9210 or other data loggers giving data to Satlink.
- When restarted, Satlink would not display the last measurement reading to the user. This would not affect transmissions or logged data, only data displayed to the user in the measurement tab of the Communicator program.

Communicator Version 3.11.02
    Enhancements:
- Communicator can talk to Satlink via Modem and/or Bluetooth.
- INSAT satellite support added for Satlink2.
- Satlink can now keep local rather than UTC time through the local time offset control.
- Measurements now have default labels.
- *Bug Fixes:*
- Communicator now properly remembers maximized position between sessions.
- Communicator will no longer overwrite save files got from different Satlinks without prompting the user.

- If user tried to both open and graph a log file, and Excel was used, Communicator would throw an error.
- If user was upgrading a Satlink with a bad main application, the select upgrade file dialog would only show Satlink1 files.

Dated august 2004
Satlink2 Version 6.04
   Bug fix:
- Analog fix: There were intermittent failures in some units to make accurate analog measurements or to turn on the switched 12V output.

Dated April 2004
Satlink 2 Version 6.02
   The first released version of Satlink 2 embedded software.
Satlink Logger Communicator version 3.8
   This was the first release of the Satlink Logger Communicator visual program which supports Satlink 2.

APPENDIX G: GOES CHANNEL DEFINITION

100 / 300 BPS CHANNEL ASSIGNMENTS

NESDIS Channel Definition	Transmit Frequency (MHz)	NESDIS Channel Definition	Transmit Frequency (MHz)	NESDIS Channel Definition	Transmit Frequency (MHz)
1	401.701000	31	401.746000	61	401.791000
2	401.702500	32	401.747500	62	401.792500
3	401.704000	33	401.749000	63	401.794000
4	401.705500	34	401.750500	64	401.795500
5	401.707000	35	401.752000	65	401.797000
6	401.708500	36	401.753500	66	401.798500
7	401.710000	37	401.755000	67	401.800000
8	401.711500	38	401.756500	68	401.801500
9	401.713000	39	401.758000	69	401.803000
10	401.714500	40	401.759500	70	401.804500
11	401.716000	41	401.761000	71	401.806000
12	401.717500	42	401.762500	72	401.807500
13	401.719000	43	401.764000	73	401.809000
14	401.720500	44	401.765500	74	401.810500
15	401.722000	45	401.767000	75	401.812000
16	401.723500	46	401.768500	76	401.813500
17	401.725000	47	401.770000	77	401.815000
18	401.726500	48	401.771500	78	401.816500
19	401.728000	49	401.773000	79	401.818000
20	401.729500	50	401.774500	80	401.819500
21	401.731000	51	401.776000	81	401.821000
22	401.732500	52	401.777500	82	401.822500
23	401.734000	53	401.779000	83	401.824000
24	401.735500	54	401.780500	84	401.825500
25	401.737000	55	401.782000	85	401.827000
26	401.738500	56	401.783500	86	401.828500
27	401.740000	57	401.785000	87	401.830000
28	401.741500	58	401.786500	88	401.831500
29	401.743000	59	401.788000	89	401.833000
30	401.744500	60	401.789500	90	401.834500

NESDIS Channel Definition	Transmit Frequency (MHz)	NESDIS Channel Definition	Transmit Frequency (MHz)	NESDIS Channel Definition	Transmit Frequency (MHz)
91	401.836000	131	401.896000	171	401.956000
92	401.837500	132	401.897500	172	401.957500
93	401.839000	133	401.899000	173	401.959000
94	401.840500	134	401.900500	174	401.960500
95	401.842000	135	401.902000	175	401.962000
96	401.843500	136	401.903500	176	401.963500
97	401.845000	137	401.905000	177	401.965000
98	401.846500	138	401.906500	178	401.966500
99	401.848000	139	401.908000	179	401.968000
100	401.849500	140	401.909500	180	401.969500
101	401.851000	141	401.911000	181	401.971000
102	401.852500	142	401.912500	182	401.972500
103	401.854000	143	401.914000	183	401.974000
104	401.855500	144	401.915500	184	401.975500
105	401.857000	145	401.917000	185	401.977000
106	401.858500	146	401.918500	186	401.978500
107	401.860000	147	401.920000	187	401.980000
108	401.861500	148	401.921500	188	401.981500
109	401.863000	149	401.923000	189	401.983000
110	401.864500	150	401.924500	190	401.984500
111	401.866000	151	401.926000	191	401.986000
112	401.867500	152	401.927500	192	401.987500
113	401.869000	153	401.929000	193	401.989000
114	401.870500	154	401.930500	194	401.990500
115	401.872000	155	401.932000	195	401.992000
116	401.873500	156	401.933500	196	401.993500
117	401.875000	157	401.935000	197	401.995000
118	401.876500	158	401.936500	198	401.996500
119	401.878000	159	401.938000	199	401.998000
120	401.879500	160	401.939500	200	401.999500
121	401.881000	161	401.941000	201	402.001000
122	401.882500	162	401.942500	202	402.002500
123	401.884000	163	401.944000	203	402.004000
124	401.885500	164	401.945500	204	402.005500
125	401.887000	165	401.947000	205	402.007000
126	401.888500	166	401.948500	206	402.008500
127	401.890000	167	401.950000	207	402.010000
128	401.891500	168	401.951500	208	402.011500
129	401.893000	169	401.953000	209	402.013000
130	401.894500	170	401.954500	210	402.014500

NESDIS Channel Definition	Transmit Frequency (MHz)	NESDIS Channel Definition	Transmit Frequency (MHz)
211	402.016000	251	402.076000
212	402.017500	252	402.077500
213	402.019000	253	402.079000
214	402.020500	254	402.080500
215	402.022000	255	402.082000
216	402.023500	256	402.083500
217	402.025000	257	402.085000
218	402.026500	258	402.086500
219	402.028000	259	402.088000
220	402.029500	260	402.089500
221	402.031000	261	402.091000
222	402.032500	262	402.092500
223	402.034000	263	402.094000
224	402.035500	264	402.095500
225	402.037000	265	402.097000
226	402.038500	266	402.098500
227	402.040000		
228	402.041500		
229	402.043000		
230	402.044500		
231	402.046000		
232	402.047500		
233	402.049000		
234	402.050500		
235	402.052000		
236	402.053500		
237	402.055000		
238	402.056500		
239	402.058000		
240	402.059500		
241	402.061000		
242	402.062500		
243	402.064000		
244	402.065500		
245	402.067000		
246	402.068500		
247	402.070000		
248	402.071500		
249	402.073000		
250	402.074500		

** NOTE
The international channels are defined as channel 1 – 33. The relationship of international channels to the numbering of 1-266 is the following: Ch 1 international = 202, Ch 2 international = 204 etc until Ch 33 international = 266. For example, ch 20 international = 240. In general, the channel number above = 2*(international channel) +200.

1200 BPS CHANNEL ASSIGNMENTS

NOTE: Enter channel number into Satlink by selecting the
baud rate and the chanel number without the "A".

NESDIS Channel Definition	Transmit Frequency (MHz)	NESDIS Channel Definition	Transmit Frequency (MHz)
1 A	401.701750	31 A	401.791750
2 A	401.704750	32 A	401.794750
3 A	401.707750	33 A	401.797750
4 A	401.710750	34 A	401.800750
5 A	401.713750	35 A	401.803750
6 A	401.716750	36 A	401.806750
7 A	401.719750	37 A	401.809750
8 A	401.722750	38 A	401.812750
9 A	401.725750	39 A	401.815750
10 A	401.728750	40 A	401.818750
11 A	401.731750	41 A	401.821750
12 A	401.734750	42 A	401.824750
13 A	401.737750	43 A	401.827750
14 A	401.740750	44 A	401.830750
15 A	401.743750	45 A	401.833750
16 A	401.746750	46 A	401.836750
17 A	401.749750	47 A	401.839750
18 A	401.752750	48 A	401.842750
19 A	401.755750	49 A	401.845750
20 A	401.758750	50 A	401.848750
21 A	401.761750	51 A	401.851750
22 A	401.764750	52 A	401.854750
23 A	401.767750	53 A	401.857750
24 A	401.770750	54 A	401.860750
25 A	401.773750	55 A	401.863750
26 A	401.776750	56 A	401.866750
27 A	401.779750	57 A	401.869750
28 A	401.782750	58 A	401.872750
29 A	401.785750	59 A	401.875750
30 A	401.788750	60 A	401.878750

SUTRON

21300 RIDGETOP CIRCLE
(703)406-2800

STERLING, VA 20166
(703)406-2801 FAX

WWW.SUTRON.COM
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NESDIS Channel Definition	Transmit Frequency (MHz)	NESDIS Channel Definition	Transmit Frequency (MHz)
61 A	401.881750	97 A	401.989750
62 A	401.884750	98 A	401.992750
63 A	401.887750	99 A	401.995750
64 A	401.890750	100 A	401.998750
65 A	401.893750	101 A	402.001750
66 A	401.896750	102 A	402.004750
67 A	401.899750	103 A	402.007750
68 A	401.902750	104 A	402.010750
69 A	401.905750	105 A	402.013750
70 A	401.908750	106 A	402.016750
71 A	401.911750	107 A	402.019750
72 A	401.914750	108 A	402.022750
73 A	401.917750	109 A	402.025750
74 A	401.920750	110 A	402.028750
75 A	401.923750	111 A	402.031750
76 A	401.926750	112 A	402.034750
77 A	401.929750	113 A	402.037750
78 A	401.932750	114 A	402.040750
79 A	401.935750	115 A	402.043750
80 A	401.938750	116 A	402.046750
81 A	401.941750	117 A	402.049750
82 A	401.944750	118 A	402.052750
83 A	401.947750	119 A	402.055750
84 A	401.950750	120 A	402.058750
85 A	401.953750	121 A	402.061750
86 A	401.956750	122 A	402.064750
87 A	401.959750	123 A	402.067750
88 A	401.962750	124 A	402.070750
89 A	401.965750	125 A	402.073750
90 A	401.968750	126 A	402.076750
91 A	401.971750	127 A	402.079750
92 A	401.974750	128 A	402.082750
93 A	401.977750	129 A	402.085750
94 A	401.980750	130 A	402.088750
95 A	401.983750	131 A	402.091750
96 A	401.986750	132 A	402.094750
		133 A	402.097750

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APPENDIX H: METEOSAT

IMPORTANT NOTE: Carefully review the channel assignment from EUMETSAT. The original channel numbering system was regional channels 1 – 33. The METEOSAT SECOND GENERATION (MSG) has channel numbering from 1 – 223. Be absolutely positive as to which channel is assigned and verify the frequency. Satlink only understands the MSG assignments (1-223) and if the assignments are given in terms of the original series, then cross the channel numbers over to the MSG numbers and enter them into Satlink. (The "R" prefix on the channel number is not entered into Satlink)

METEOSAT CHANNEL ASSIGNMENTS

METEOSAT "MSG" Channel Definition	METEOSAT original regional	Transmit Frequency (MHz)	METEOSAT "MSG" Channel Definition	METEOSAT original regional	Transmit Frequency (MHz)	METEOSAT "MSG" Channel Definition	METEOSAT original regional	Transmit Frequency (MHz)
R001	R1	402.101500	R031	R16	402.146500	R061	R31	402.191500
R002		402.103000	R032		402.148000	R062		402.193000
R003	R2	402.104500	R033	R17	402.149500	R063	R32	402.194500
R004		402.106000	R034		402.151000	R064		402.196000
R005	R3	402.107500	R035	R18	402.152500	R065	R33	402.197500
R006		402.109000	R036		402.154000	R066		402.199000
R007	R4	402.110500	R037	R19	402.155500	R067		402.200500
R008		402.112000	R038		402.157000	R068		402.202000
R009	R5	402.113500	R039	R20	402.158500	R069		402.203500
R010		402.115000	R040		402.160000	R070		402.205000
R011	R6	402.116500	R041	R21	402.161500	R071		402.206500
R012		402.118000	R042		402.163000	R072		402.208000
R013	R7	402.119500	R043	R22	402.164500	R073		402.209500
R014		402.121000	R044		402.166000	R074		402.211000
R015	R8	402.122500	R045	R23	402.167500	R075		402.212500
R016		402.124000	R046		402.169000	R076		402.214000
R017	R9	402.125500	R047	R24	402.170500	R077		402.215500
R018		402.127000	R048		402.172000	R078		402.217000
R019	R10	402.128500	R049	R25	402.173500	R079		402.218500
R020		402.130000	R050		402.175000	R080		402.220000
R021	R11	402.131500	R051	R26	402.176500	R081		402.221500
R022		402.133000	R052		402.178000	R082		402.223000
R023	R12	402.134500	R053	R27	402.179500	R083		402.224500
R024		402.136000	R054		402.181000	R084		402.226000
R025	R13	402.137500	R055	R28	402.182500	R085		402.227500
R026		402.139000	R056		402.184000	R086		402.229000
R027	R14	402.140500	R057	R29	402.185500	R087		402.230500
R028		402.142000	R058		402.187000	R088		402.232000
R029	R15	402.143500	R059	R30	402.188500	R089		402.233500
R030		402.145000	R060		402.190000	R090		402.235000

METEOSAT "MSG" Channel Definition	Transmit Frequency (MHz)	METEOSAT "MSG" Channel Definition	Transmit Frequency (MHz)	METEOSAT "MSG" Channel Definition	Transmit Frequency (MHz)
R091	402.236500	R131	402.296500	R171	402.356500
R092	402.238000	R132	402.298000	R172	402.358000
R093	402.239500	R133	402.299500	R173	402.359500
R094	402.241000	R134	402.301000	R174	402.361000
R095	402.242500	R135	402.302500	R175	402.362500
R096	402.244000	R136	402.304000	R176	402.364000
R097	402.245500	R137	402.305500	R177	402.365500
R098	402.247000	R138	402.307000	R178	402.367000
R099	402.248500	R139	402.308500	R179	402.368500
R100	402.250000	R140	402.310000	R180	402.370000
R101	402.251500	R141	402.311500	R181	402.371500
R102	402.253000	R142	402.313000	R182	402.373000
R103	402.254500	R143	402.314500	R183	402.374500
R104	402.256000	R144	402.316000	R184	402.376000
R105	402.257500	R145	402.317500	R185	402.377500
R106	402.259000	R146	402.319000	R186	402.379000
R107	402.260500	R147	402.320500	R187	402.380500
R108	402.262000	R148	402.322000	R188	402.382000
R109	402.263500	R149	402.323500	R189	402.383500
R110	402.265000	R150	402.325000	R190	402.385000
R111	402.266500	R151	402.326500	R191	402.386500
R112	402.268000	R152	402.328000	R192	402.388000
R113	402.269500	R153	402.329500	R193	402.389500
R114	402.271000	R154	402.331000	R194	402.391000
R115	402.272500	R155	402.332500	R195	402.392500
R116	402.274000	R156	402.334000	R196	402.394000
R117	402.275500	R157	402.335500	R197	402.395500
R118	402.277000	R158	402.337000	R198	402.397000
R119	402.278500	R159	402.338500	R199	402.398500
R120	402.280000	R160	402.340000	R200	402.400000
R121	402.281500	R161	402.341500	R201	402.401500
R122	402.283000	R162	402.343000	R202	402.403000
R123	402.284500	R163	402.344500	R203	402.404500
R124	402.286000	R164	402.346000	R204	402.406000
R125	402.287500	R165	402.347500	R205	402.407500
R126	402.289000	R166	402.349000	R206	402.409000
R127	402.290500	R167	402.350500	R207	402.410500
R128	402.292000	R168	402.352000	R208	402.412000
R129	402.293500	R169	402.353500	R209	402.413500
R130	402.295000	R170	402.355000	R210	402.415000

METEOSAT "MSG" Channel Definition	Transmit Frequency (MHz)
R211	402.416500
R212	402.418000
R213	402.419500
R214	402.421000
R215	402.422500
R216	402.424000
R217	402.425500
R218	402.427000
R219	402.428500
R220	402.430000
R221	402.431500
R222	402.433000
R223	402.434500

SATLINK 2 LOGGER AND TRANSMITTER OPERATIONS & MAINTENANCE MANUAL

APPENDIX I: INSAT

INSAT is not supported by all versions of Satlink Logger software. **Only versions 6.03 and newer support INSAT**.

INSAT units have an auxiliary cable that provides Clock, Data and Transmit RF Gate that is provided on a special connector. (TBD)

Transmission time and INSAT:
An INSAT transmission is really a set of either three or six individual transmissions made within a ten minute time window. The ten minutes get spilt up into either three or six separate windows, during each of which one transmission will occur. The exact time of each transmission is randomized during that short window. Whether three or six transmission are made depends on the amount of data to be transmitted. If up to ten sensor readings are to be transmitted, three transmission are made; more than 10 sensor readings will result in six transmissions. If data is given to Satlink by another device, then the amount of data given will determine how many transmissions are made.

If six transmissions are being made, the first three are made with the user-set satellite ID. The second three are made with either the second satellite ID (if the user entered it), or by transforming the first satellite ID (more details on the second satellite ID follow).

The Offset and Interval settings of Satlink's scheduled transmission determine when the ten minute window starts. For example, if you set the Offset to 00:20:00 and the Interval to 01:00:00, Satlink will make the transmissions once an hour, sometime between 20 and 30 minutes past the hour.

You cannot setup Satlink to do random transmission for INSAT.

Second satellite ID (versions 5.06 and newer only)
If INSAT is selected as the transmission type in the scheduled tab of the Communicator program, a field for the second satellite ID appears. The use of this field is optional. By setting the field value to 0 or to 0xFFFFFFFF, the user indicates that he does not want to use this field.
The second satellite ID would be used for the second batch of three transmissions. If the second ID is not set, and six transmission are being made, a transformation of the original satellite ID will be used.
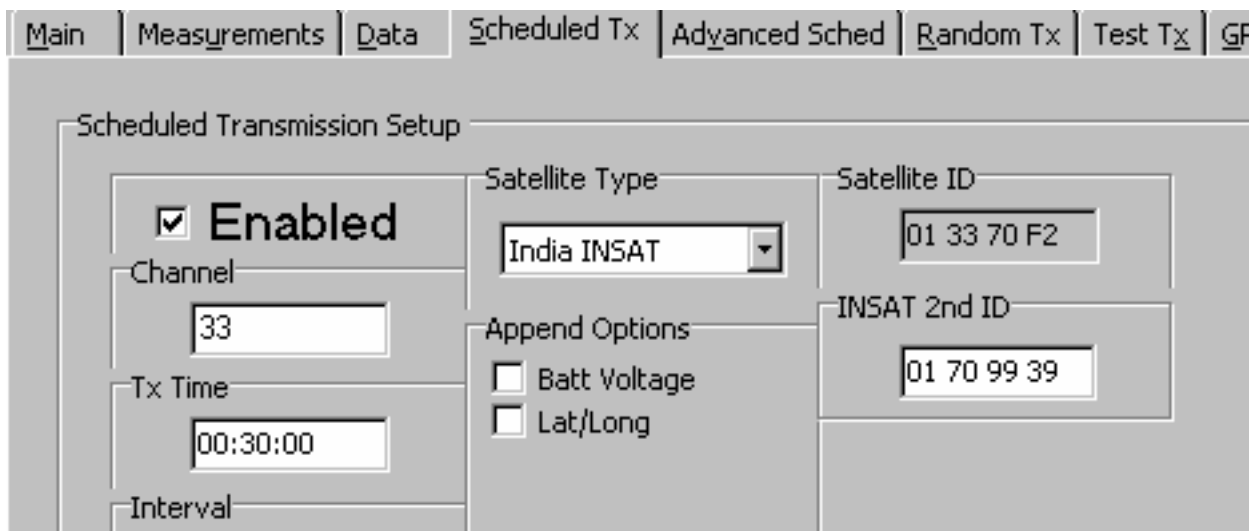
Transmission data and INSAT:

Satlink can transmit data given to it by another device (such as the Sutron Xpert). It can also transmit data it collects. When Satlink is given data by another device, it transmits the data without formatting. If Satlink is collecting the data itself, it will format each measurement marked for transmission. The measurement result must be between 0 and 1023, because those are the only values that can be transmitted. If the measurement is less than 0, it will be transmitted as 0. If it is greater than 1023, it will be transmitted as 1023. Use the Scale and Offset settings of the measurement to ensure a transmittable value. Missing measurements have 0 transmitted.

Transmission and logging different values:
If you are setting up a measurement and want to transmit and log different values, do the following: Setup two measurements. Set them up identically (same measurement type, same time and interval, etc.) except that one is setup for logging and the other for transmitting. The one setup for transmitting needs to have a scale and an offset to put the number between 0 and 1023. Setup this measurement to be included in the transmission, but do not set it up for logging. The second measurement should be setup for logging, but not for transmitting. The second measurement should not be scaled to result in a number between 0 and 1023.

Example:
Satlink is setup to collect temperature information from an SDI device. The temperature is in Celsius, and we expect the reading to be anywhere between -40ºC and +80ºC. In order to log a value in degrees Celsius and to transmit a legal value (between 0 and 1023), we setup two measurements. The first we call TempTx and we will use it for transmitting the data. To make the temperature reading transmittable, we have to transform it so that the result is between 0 and 1023. To that end, we will set the offset to 40 (and leave the slope at 1). This means that after reading the temperature, we will add 40 to the reading, which will put it into the transmittable range. Once the data is transmitted via the satellite and received by the ground station, the data will have to be transformed back by having 40 subtracted from it. (Note that the transmitted value does not keep any fractional parts (i.e. 21.7ºC will become 21ºC).

The second measurement we will call TempLog. It will be setup for logging, without any offset, and it will not be transmitted.

Note that even though two measurements are setup, since their measurement type and schedules are identical, Satlink will only take one reading from the SDI sensor. This ensures consistency between the logged and transmitted values.

Formatting measurement data into columns:

A transmitted message will contain ten columns, each with a measurement reading. Measurements get transmitted in the order they have been setup. If measurement one has been setup to transmit four values, and measurement two setup to transmit two values, then the transmitted data will contain measurement one in the first four columns, and measurement two in the next two. The only way to get a measurement in a specific column is to setup the measurements sequentially. For example, if you wish to transmit a rain reading in column four and have the first three columns blank, you will need to setup measurement one to be a dummy measurement that will transmit three readings, and setup rain to be measurement two that will transmit one reading.

Mixing measurement and external data:

Satlink can do a merged data transmission in which it formats the first three transmissions from sensor readings it has made, and transmits data given to it by another device in the last three transmissions. In order for merged data mode to work, Satlink must be setup to transmit ten or less sensor readings, otherwise it will fill up all six transmissions with its own data.

APPENDIX J: 40 WATT SATLINK VARIANT (SL2-B40W-1)

A variant of Satlink2 is produced which is essentially a modified Satlink2 that outputs 40 Watts of RF output power. This version is designed for stations that require an Omnidirectional antenna either because the station is moving or multiple satellites are required. A buoy station is a good example of this application.

This 40 Watt mode is not supported by all versions of Satlink Logger software. **Only versions 6.08 and newer support 40 Watts in addition to the hardware modifications.**

GENERAL:

The 40 Watt Transmitter has been accomplished by adding a 6 dB gain amplifier to the top of a Satlink 2. This amplifier adds 6 dB to the top of a 10 watt setting (+40 dBm) and results in a 40 Watt output (46 dBm) at 12.5 Volts.

ENHANCED CAPABILITIES:

- **40 Watts output for Omnidirectional antenna**
- **Power output is the same for any baud rate 100, 300 or 1200 bps.**
- **The switched 12 Vdc output (for sensor warmup) now turns on (in addition to the prior capabilities) just prior to a transmission and turns off following the transmission. This is configured to control and external switch to power the booster amplifier.**

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INSTALLATION:

The installation of a SL2-B40W-1 is approximately the same as installing a regular Satlink 2. Care should be taken to accomplish the following:

- Never mount Satlink2 in a wet and condensing environment. This may cause significant damage to the connectors.
- Always be sure to provide a high quality return to ground for proper lightning protection.
- Always use heavy gauge wire, such as 14 or 16 Ga for connections to batteries if the supplied cables are not long enough. It is highly recommended to NEVER extend the DC cables to the battery if at all possible.
- If using the optional switch to control the power to the amplifier, verify that all connections are per the included instructions. Securely mount all switches and tie all cables to prevent accidental disconnections.
- NEVER USE A YAGI antenna with the 40 watt transmitter. Only use the 3 or 3.5 dB gain OMNI antenna or power levels will be exceeded on the satellite.

OPERATION:

The customer will not experience any difference in operation of the Satlink2 as compared to a standard Satlink 2. When ordered, the Satlink 2 40 Watt (SL2-B40W-1) will be shipped factory set at the proper 40 Watt level. No further adjustments are available to the customer. However, the customer must pay particularly close attention to the DC power connections to the battery. The amplifier will draw significantly more current than a standard Satlink 2 in order to generate 40 Watts. All connections should be made directly to the battery and if some additional wiring is required, then heavy gauge wiring is required. (See above)

Unlike regular Satlink 2 operation where 7 watts is used for 100 and 300 bps and 14 watts is used for 1200 bps, the SL2-B40W-1 will transmit the same 40 Watt level for all baud rates, 100, 300 and 1200 bps.

QUIESCENT POWER :

The Satlink will consume the same amount of standby current as long as the amplifier is switched using the optional amplifier switch kit. If this switch option is not used, then it will be up to a secondary payload/logger to switch the power.   If non switched operation is desired, then the quiescent power will increase by approximately 400 ma.

APPENDIX K: MOUNTING PATTERN
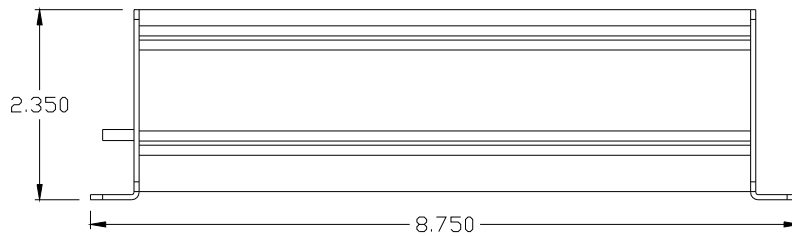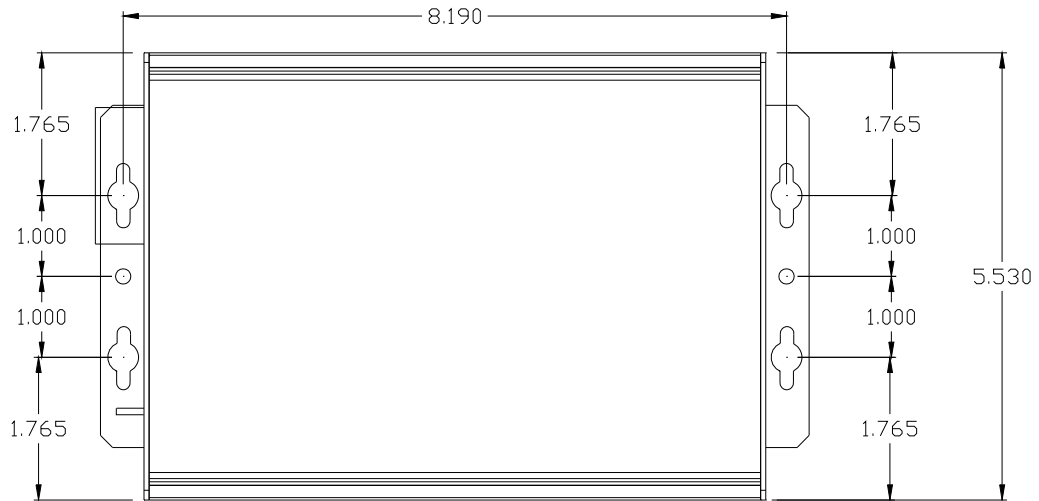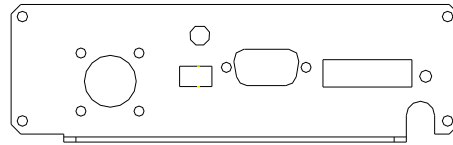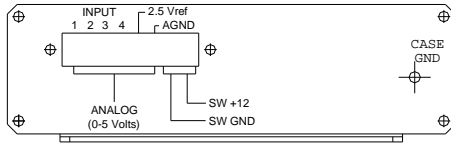
WITH CONNECTORS SHOWING.

.60 to outside of connectors, leave room to
connect wire and for the rf cable.
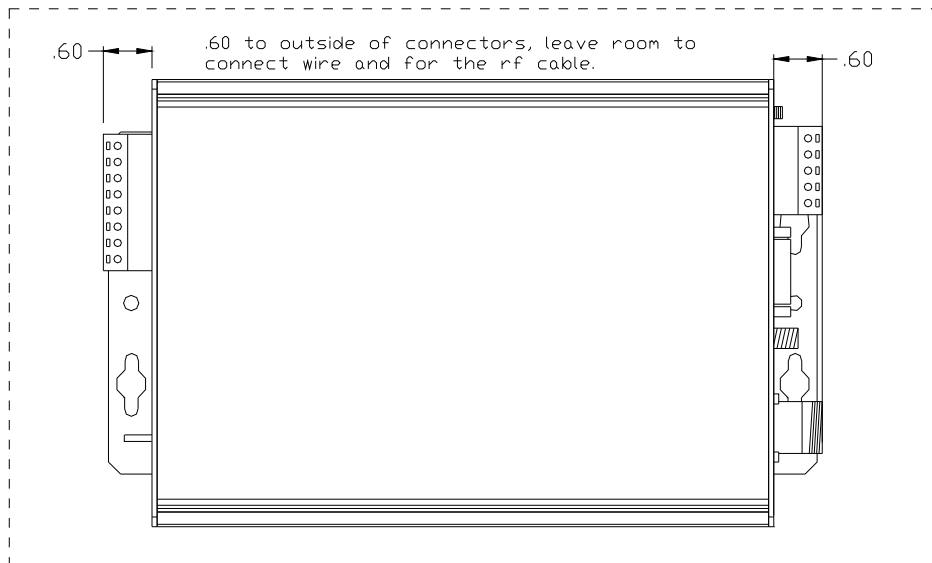
APPENDIX L: ARGOS

ARGOS is not supported by all versions of Satlink Logger software. **Only versions 6.08 and newer support ARGOS**.

ARGOS data gets formatted in a unique way. Each measurement marked for transmission (see the section on measurements on page 47) will be encoded into a specific number of bits. The number of bits defaults to 16. The "Label" field of the measurement can be used to specify how many bits to encode for that measurement. For example, if the "Label" field is set to be "Stg:32", then all readings of that measurement to be transmitted will be encoded into 32 bits. How many readings are to be transmitted is specified using the "Num vals to Tx" field.

ARGOS allows up to 256 bits of sensor data (unless the ID is a 28 bit ID in which case only 248 bits are allowed). With the default setting of 16 bits per reading, 16 different readings could be transmitted. Those could be 16 readings of the same measurement, or 8 readings of two different measurements, or any other combination.

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