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Sutron Satlink 3 ISCO sampler control application using a Python script

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This document describes a Sutron Satlink 3 setup and Python script. The goal is to provide our USGS customer with an automated way of triggering an ISCO sampler.

At the current installation site, there is a Sutron Satlink 3 measuring turbidity, temperature, and SC on site, as well as a programmable ISCO sampler (not connected to Satlink). Currently, customer has to manually setup for rain events by going to site prior to an event and programming the ISCO sampler to collect data on a schedule. Customer desires that Satlink automatically trigger the sampler based on turbidity conditions.

The goal is twofold:

- Decrease the number of visits to the site
- Improve the collection of the water samples

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Sampling criteria

There are multiple criteria that may result in the triggering of the sampler.
References to GP are to the General Purpose variables in setup – see the next section.

Baseline

The system will trigger the sampler based on a user entered interval expressed in hours, default 99.
Initial operation - trigger after the initial interval expires, 99 hours after bootup by default
There are no additional qualifiers for this sampler trigger except for exceeding bottle capacity.
This setting is GP1, BaselineHours

Change Since Last Trigger

Compare current turbidity reading with the last reading that triggered the sampler. If the absolute difference exceeds user set threshold (default 250), trigger the sampler.
This setting in GP2, ChangeSinceTrigger

Minimum time between sampler triggers

This value may be used to restrict how often the sampler may be triggered.
By default, this is set to zero hours, meaning sampler may be triggered as frequently as possible.
This setting is GP3, TriggerDeadtimeHrs and is expressed in hours

High Threshold

If turbidity is higher than a user set level (default 2000), the system will sample periodically at a user set interval (default 1 hour).
High Threshold will combine with Change Since Last Trigger, allowing for even faster triggering if the turbidity change is high enough.
The threshold is GP4 HighThreshold
The interval is GP5 HighIntervalHrs

Bottle count

Sampler holds a limited number of bottles, dictating how many times it may be triggered.
The default value is 24.
This setting is GP6, BottleCapacity

- The system will track bottles used, and not attempt to trigger sampler once all bottles are used up.
- The number of bottles used is setup as a measurement, so the value can be transmitted over GOES and setup for alarms.

- Bottle count may be reset via script task S1.
- Bottle count will be reset to 0 on power up. If it is important for this value to persist across reboots, it may be placed into a GP.

SMS

The system will send SMS when most of the bottles are used up (default is 22).

- A telemetry setup will be used to setup the SMS phone numbers and the frequency of the alarm.
- A measurement will be setup to track bottles used. An alarm will be setup on this measurement. The alarm will trigger the SMS.

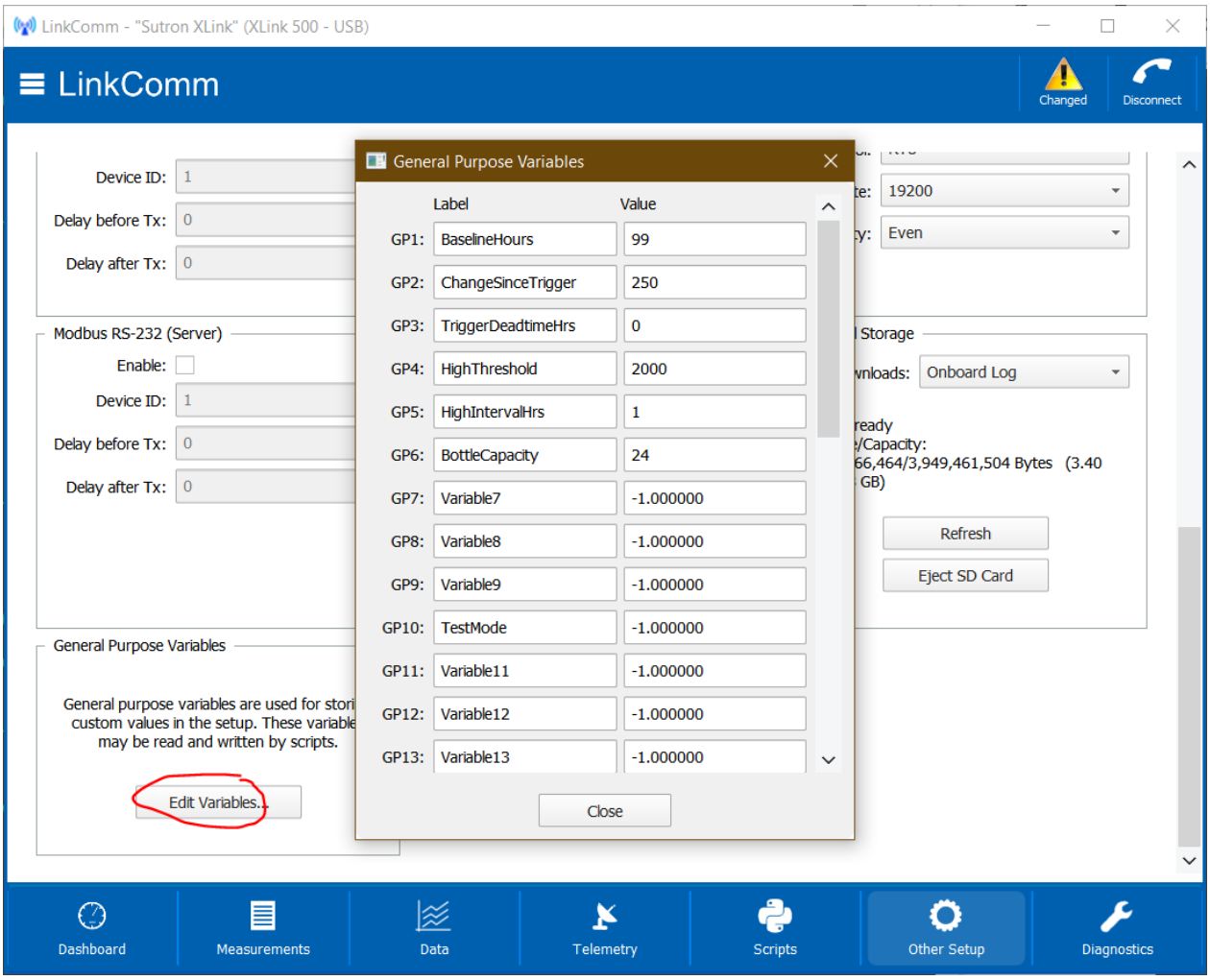
Physical interface

Satlink's digital output 1 will be used to trigger the ISCO sampler.

Setup

General Purpose Variables (GP)

These are general purpose setup fields, accessible via LinkComm->Other tab->General Purpose Variables->Edit Variables.



Script Status

The script status provides information on the sampler status:

- The number of bottles used
- The time the sampler was last triggered
- The reason for the trigger
- Turbididty at the time of the trigger
- Current turbididty

See the screenshot below for where to find the Script Status in LinkComm.

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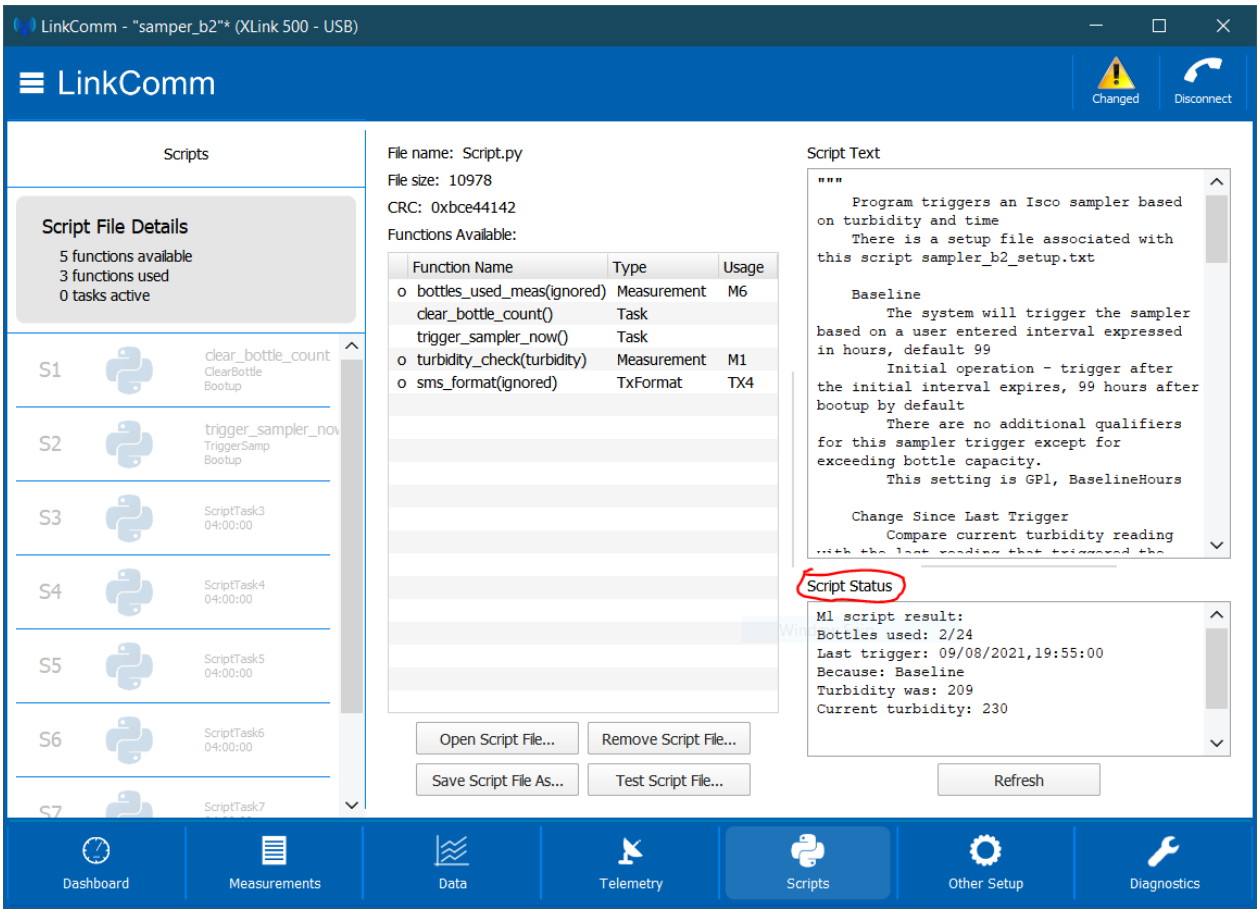

Status via SMS

Note that the Script Status is identical to the SMS sent as the system goes into alarm.

To get the status via SMS at any time, send an SMS to the station with this exact command: !STATUS SCRIPT

Please note that Satlink will turn off the cell modem to conserve power. Check Other Setup->Cell to control how often messages are checked (Msg interval) or make the modem stay on all the time (enable Listening)

Script Tasks

Two script tasks have been setup to allow manual control:

- S1 ClearBottle
- S2 TriggerSamp

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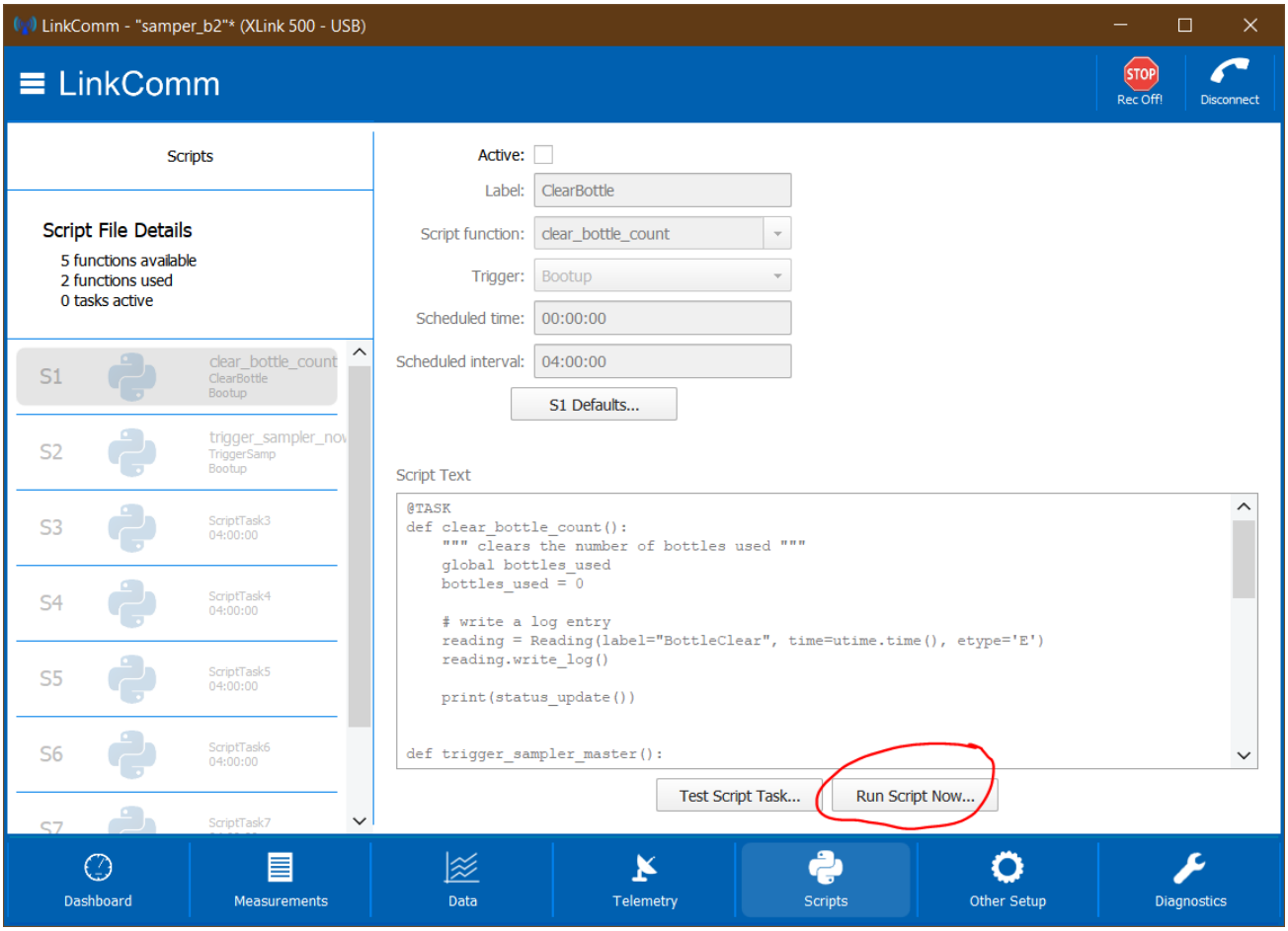
Both of these tasks are intentionally not active. They are not meant to run automatically, but to be invoked by the user by pressing the Run Script Now butoon in LinkComm (LinkComm->Script Tab->S1 (or S2)->Run Script Now

The S1 ClearBottle script will clear the number of bottles and reset other trackers.
The S2 TriggerSamp will trigger the sampler immediately.

These scripts may be invoked by sending an SMS with the following content:
!S1 SCRIPTRUN
or
!S2 SCRIPTRUN

Note script task is not active, but may be run anyway via LinkComm's Run Script Now button. Script Task S2 may be likewise run in order to trigger the sampler.



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Measurement setup

Turbidity

M1 is turbidity. It is linked to the script and is the primary cause for triggering the sampler.

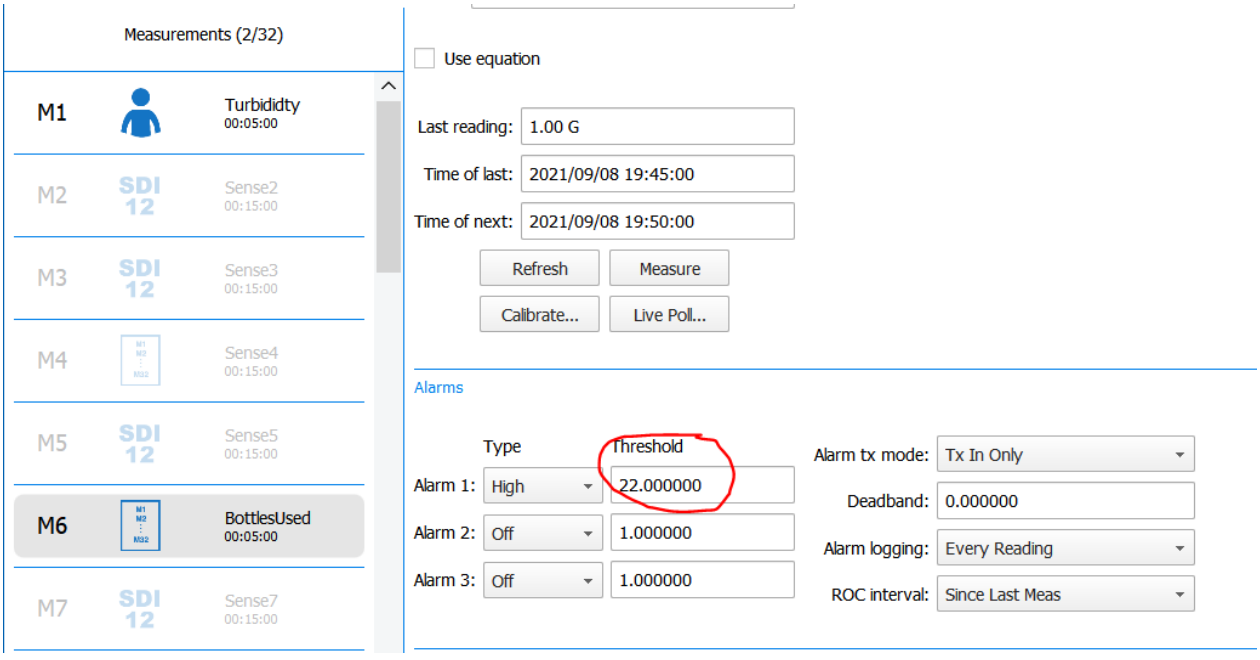
Bottles Used

M6 is bottles used. The value is generated by the script and represents the number of USED bottles so far.

- It resets to zero every bootup.
- It may be manually reset to zero via S1 Script Task.
- **Calibrating this value via the measurement tab will not work.**

M6 is also used to trigger SMS when the bottle count reaches the limit. Setup the Alarm 1 Threshold to the desired number of bottles used. Once the system reaches this number, it will send SMS to the phone numbers setup via Telemetry (see below).

M6 is required to send SMS. If logging this value is not desired, change the Logging setting to Do Not Log.



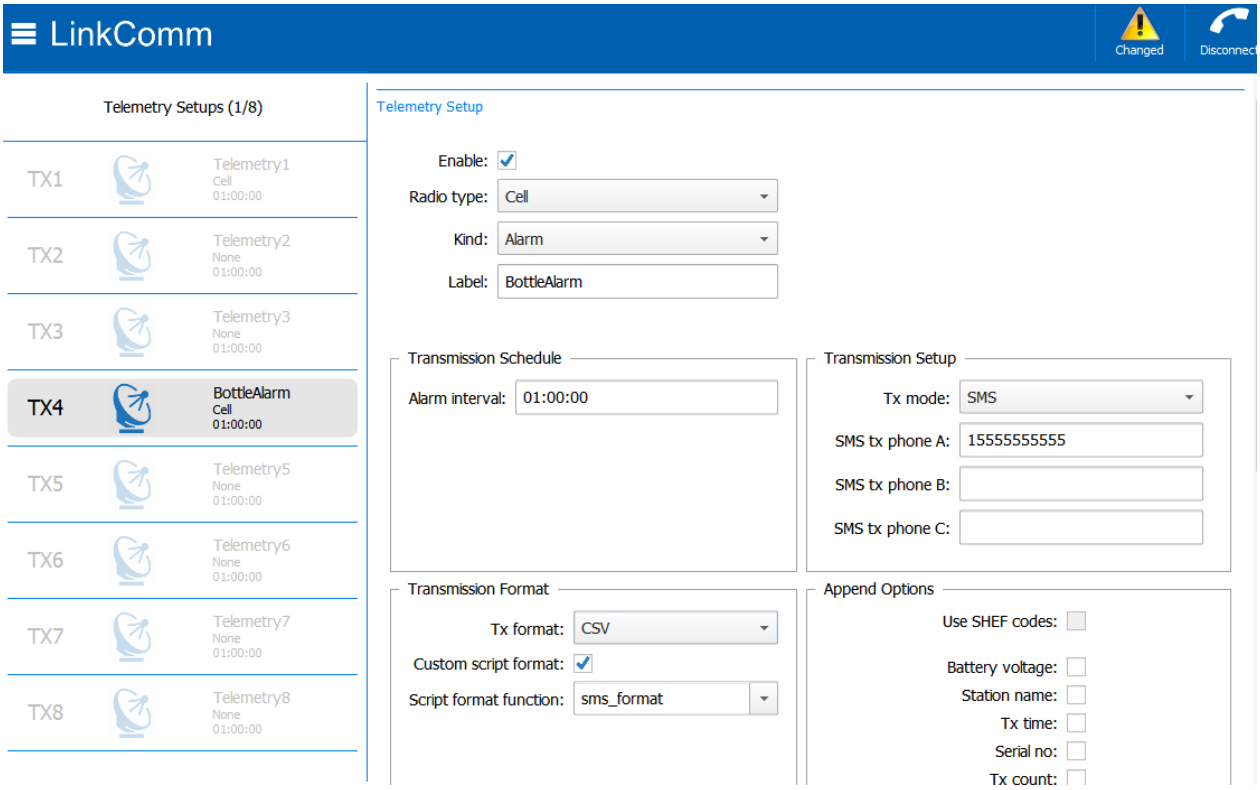
Telemetry setup

TX4 is setup as an alarm tx. It sends SMS when the bottle count reaches threshold.

The content of the text message is the same as shown for Script Status.

Modify TX4 and add the correct SMS phone numbers for up to three recipients. If you require more, setup TX5 to look exactly like TX4, but to have the rest of the phone numbers.

As long as the bottle count exceeds the threshold, the system will keep sending alarms! Alarm interval controls how often this happens. Set alarm interval to zero to have only one set of SMS sent.



Test Mode

To test how the script behaves without a sampler or a turbidity sensor, do the following:

- To rig the turbidity values, modify python script file
  - Search for test_turbidity
  - Modify the list of values to have the turbidity readings that you would like to test
  - The system will sequentialy read the list, and use the values as if they were produced by the turbidity sensor
- Set GP10, TestMode to +1.0
  - To disable test mode, set GP10 to -1

- Increase the measurement interval
  - Otherwise you will be waiting a long time to test the script!
- Baseline interval
  - This value defaults to 99 hours. If you want to test the baseline, change it to a small number (0.5 is half an hour, 0.1 is 6 minutes).

Logged Data

In addition to logging measurements, Satlink will log data as it controls the sampler. To view this data, you will need to select the Include Events option in LinkComm. Also check the download Options for downloading one log file (with both meas and events) or two log files (one for meas, one for events).

These are the events logged:

- Triggered
  - Indicates that the sampler was triggered
  - Includes the bottle count
- The cause of the trigger will be one of the following:
  - User
  - Baseline
  - ChangeSince (change since last trigger)
  - Threshold