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RST Instruments ELS Horizontal Tilt Beam

Sensor Application Note #12

Overview

The RST Instruments Electrolytic Sensor (ELS) Horizontal Tilt Beam is used to measure differential movements in structures. The ELS Beam consists of a uniaxial or biaxial electrolytic tilt sensor and thermistor mounted inside a fiberglass beam, power is supplied with a nominal 12VDC supply. The on-board electronics assembly provides signal conditioning and a total of 3 outputs for the uniaxial version, a 1.25VDC reference, 0-2.5VDC tilt sensor and temperature outputs. The biaxial version includes a second 0-2.5VDC tilt output. To read the sensor outputs differential measurements are made between 1.25VDC reference and the sensor outputs. The electronics assembly also includes multiplexing, a single cable can be used to interconnect, or buss, an entire series of units, operation is similar to numerous commercially available multiplexers, such as the ANE MiniMux, ANE MultiMux or the Campbell AM416.

Note: The support in MultiLogger for these sensor types was added beginning with version 2.1.6, contact your software vendor or Canary Systems to obtain software updates.

Wiring

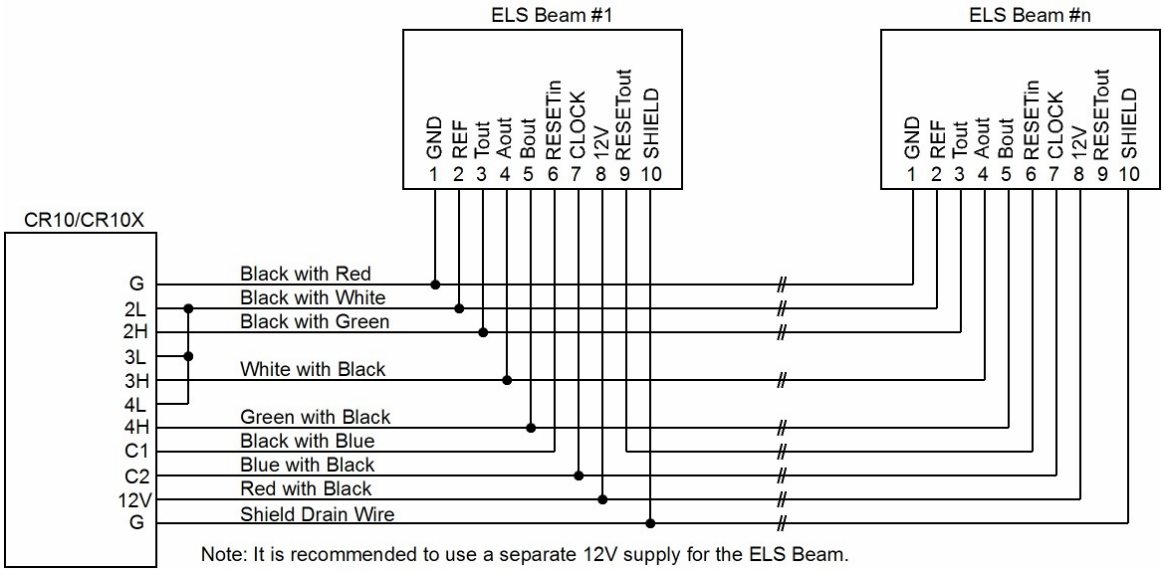
See the following table for a description of the output pins and wiring panel connections.

Pin	Description	Belden Cable	CR10X WP Connection
1	Ground	Black paired with Red	G
2	Reference	Black paired with White	2L, 3L, 4L[1]
3	Temperature	Black paired with Green	2H
4	A Signal	White paired with Black	3H
5	B Signal	Green paired with Black	4H[1]
6	RESET IN	Black paired with Blue – IN	C1[2]
7	CLOCK	Blue paired with Black	C2[3]
8	12VDC	Red paired with Black	12V[4]
9	RESET OUT	Black paired with Blue – OUT	NA[5]
10	Shield	Shield Drain Wire	G

Notes:
[1] Connect only if using Biaxial ELS Beam.
[2] This connection will only be made on the first unit, subsequent units will connect to the RESET OUT terminal. The recommended maximum number of units per string is 32, for more sensors build additional strings, wired to different control ports, e.g. the second string would use C3 for RESET and C4 for CLOCK.
[3] The maximum number of recommended units is 32. See note 2 regarding control port usage for additional strings.
[4] It is highly recommended to use a separate fused 12VDC power supply to power the ELS Beams, this will avoid compromising the system power in case of short-circuit or other problem with a potentially lengthy cable bussing the units.
[5] RESET OUT will be connected to the next unit in series.

It is recommended to use a 22AWG multi-pair shielded cable, with non-PVC conductor insulation, see Belden 8777 or Alpha 5108C. See the RST ELS Horizontal Tilt Beam Installation Manual for more information on the wiring and other installation issues.

Non-MultiSensor Multiplexer Wiring



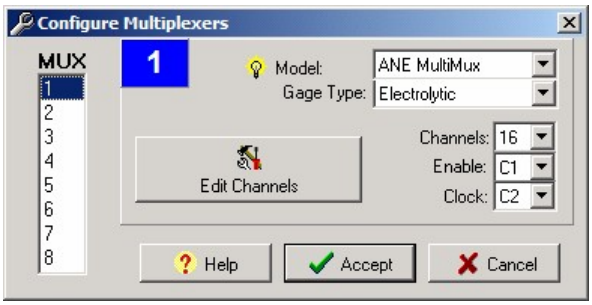
Contact Canary Systems for MultiSensor configurations.

MultiLogger Configuration

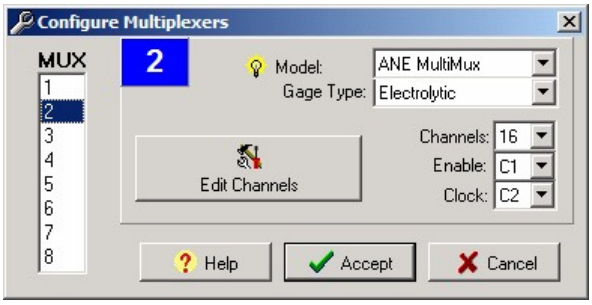
There are 3 software configuration issues with setting up MultiLogger to read the ELS Beam. The following information will detail configuration of the Uniaxial ELS Beam, contact Canary Systems for information regarding configuration of Biaxial ELS Beam units.

Multiplexer Configuration

The bussing of the ELS Beam works similarly to a number of multiplexers supported by MultiLogger, e.g. the ANE MiniMux, ANE MultiMux or Campbell AM416. If the string consists of fewer than 16 sensors then a single multiplexer can be used to read the sensors, if the string consists of more than 16, but less than 33, then 2 multiplexers must be configured using a "daisy-chain" configuration, i.e. where the same **Enable** and **Clock** are used for both multiplexers. For example, if a single multiplexer is required then configure Multiplexer #1 as shown.



If the buss consists of between 17 and 32 sensors then configure multiplexer #2 as shown. Note the **Enable** and **Clock** settings for multiplexer #1 and multiplexer #2 match, this will result in "daisy-chain" operation, meaning the Enable output of the control module is kept high between the multiplexers.

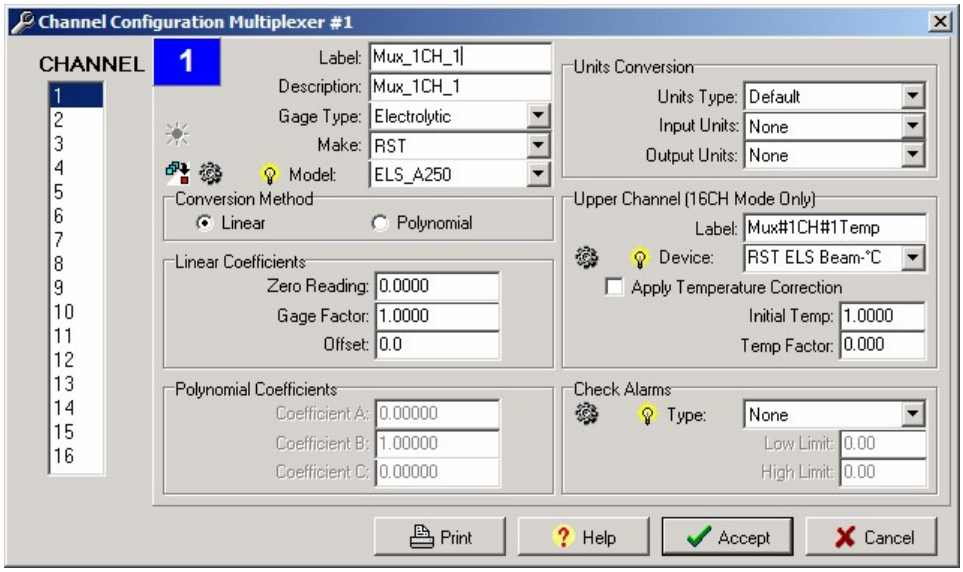


It is NOT recommended to attempt connecting more than 32 ELS Beams on a single buss, in this case create a second buss for the additional sensors, or utilize more data acquisition systems.

Up to 4 strings, each consisting of up to 32 Uniaxial ELS Beams, may be configured using MultiLogger.

Channel Configuration

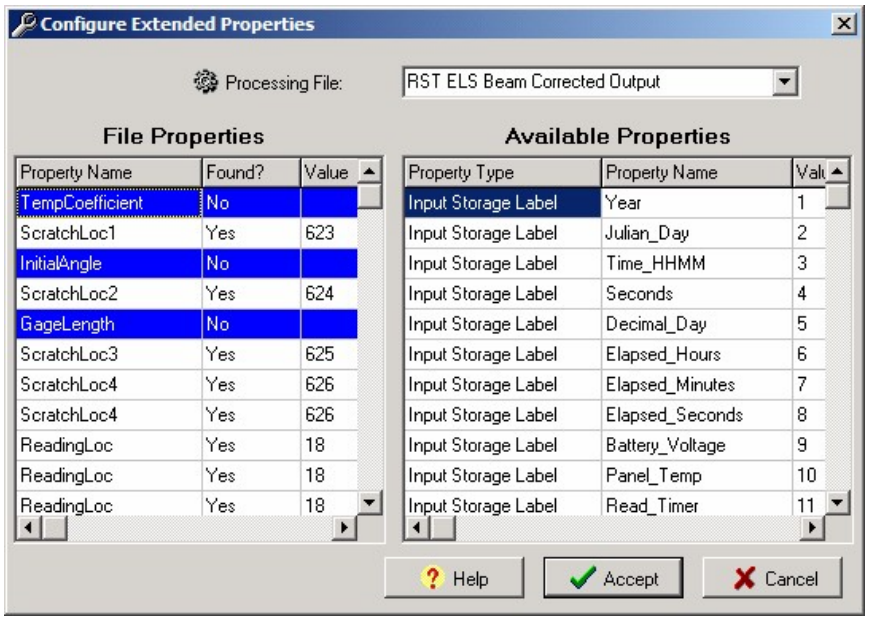
Individual channels must then be configured to read the A output and the Temperature output of the ELS Beam. Select the **Gage Type | Make | Model**, to read the A or B output of the ELS Beam, e.g. **ELS_A250** or **ELS_B250**. Configure the **Upper Channel** to read the temperature, in degrees Celsius or Fahrenheit, select **RST ELS Beam-°C** or **RST ELS Beam-°F**, respectively.



Note: The A or B output can be configured to read with a 2500mV full-scale range by selecting the Model with the 2500 suffix, e.g. **ELS_A2500** or **ELS_B2500**. It is recommended to use the 250mV full-scale range selection, as shown above with the 250 suffix, but if the readings go out of range and it is not possible to re-zero the Beams then switch to the 2500mV full-scale range.

Extended Properties Configuration

The output of the A or B ELS Beam measurement is in volts, it is often desired to correct this output for temperature change as well as include the calibration factors to convert to degrees and then to deflection. These conversions can be done using the Extended Properties function of MultiLogger. Press the Extended Properties button  , shown to the left of the Model on the Channel Configuration form. This invokes the Extended Properties form, then select the Processing File **RST ELS Beam Corrected Output**, as shown.



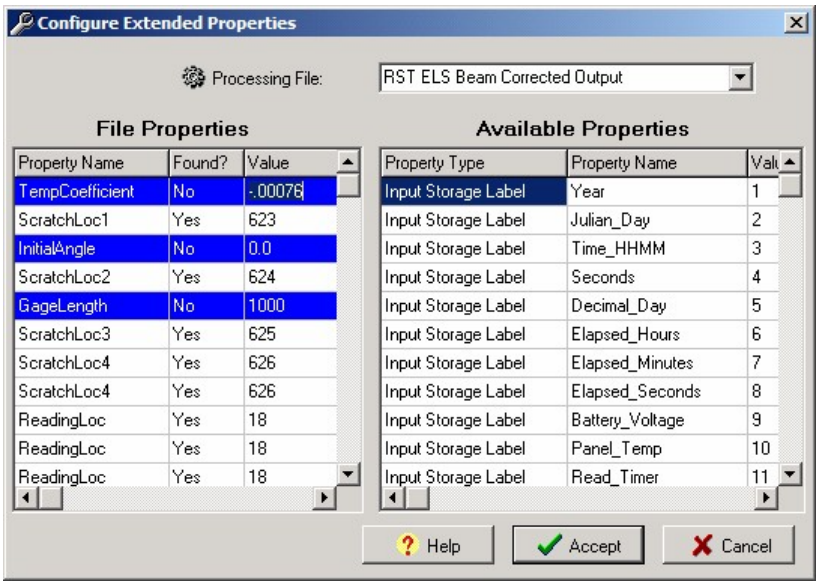
You will notice a list of properties under **File Properties**, the ones shown in blue are the values that must be entered for the correction to be applied. This Processing File will perform the following steps, as also described in the RST ELS Horizontal Tilt Beam Installation Manual.

1) Correct the output for temperature change.
2) Convert the output to angle.
3) Obtain the SIN of the current angle.
4) Obtain the SIN of the initial angle.
5) Subtract the initial angle from the current angle.
6) Convert the change to deflection.

See the formulas on pages 8 and 9 of the RST ELS Horizontal Tilt Beam Installation Manual for additional information regarding these calculations, see the example on page 10.

Other functions could also be performed, such as accumulating the deflections to obtain profile, contact Canary Systems for information regarding this functionality.

To enter values left-click on the cells in Value column, for rows shown in blue, and type the value, an example is shown.



The following values will need to be entered:

TempCoefficient – Temperature coefficient, from the RST ELS Beam calibration sheet.
InitialAngle – Determined at time of installation from the initial corrected output of the Beam. To obtain this value using MultiLogger configure the Extended Properties but enter **0.0** as the Initial Angle and **1.0** as the GageLength, then Update the system and record the value shown.
GageLength – The length of the Beam, in feet, inches, meters, or millimeters. This also represents the output units, e.g. if the beam length is 3 meters then enter 3000 to output change in deflection in units of millimeters, or if the beam length is 10 feet then enter 120 to output change in deflection in units of inches. The example shown above illustrates deflection output in millimeters for a 1 meter beam.
Coeff_C0 – The calibration coefficient C0, from the RST ELS Beam calibration sheet.
Coeff_C1 – The calibration coefficient C1, from the RST ELS Beam calibration sheet.
Coeff_C2 – The calibration coefficient C2, from the RST ELS Beam calibration sheet.
Coeff_C3 – The calibration coefficient C3, from the RST ELS Beam calibration sheet.
Coeff_C4 – The calibration coefficient C4, from the RST ELS Beam calibration sheet.
Coeff_C5 – The calibration coefficient C5, from the RST ELS Beam calibration sheet.

Note: You will need to scroll down the File Properties list to enter the calibration coefficients.

When finished press **Accept** to save these settings in your configuration file, you will need to enter these values for EACH CHANNEL of the multiplexer, use the respective calibration sheets supplied with each ELS Beam.