INSTRUCTION MANUAL

255-100 Novalynx Analog Output Evaporation Gauge

1/09

Warranty and Assistance

The **255-100 NOVALYNX ANALOG OUTPUT EVAPORATION GAUGE** is warranted by CAMPBELL SCIENTIFIC, INC. to be free from defects in materials and workmanship under normal use and service for twelve (12) months from date of shipment unless specified otherwise. Batteries have no warranty. CAMPBELL SCIENTIFIC, INC.'s obligation under this warranty is limited to repairing or replacing (at CAMPBELL SCIENTIFIC, INC.'s option) defective products. The customer shall assume all costs of removing, reinstalling, and shipping defective products to CAMPBELL SCIENTIFIC, INC. CAMPBELL SCIENTIFIC, INC. will return such products by surface carrier prepaid. This warranty shall not apply to any CAMPBELL SCIENTIFIC, INC. products which have been subjected to modification, misuse, neglect, accidents of nature, or shipping damage. This warranty is in lieu of all other warranties, expressed or implied, including warranties of merchantability or fitness for a particular purpose. CAMPBELL SCIENTIFIC, INC. is not liable for special, indirect, incidental, or consequential damages.

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255-100 Novalynx Analog Output Evaporation Gauge

1. General

Novalynx Corporation manufacturers the 255-100 Analog Output Evaporation Gauge and the 255-200 Class A Evaporation Pan. The 255-100 consists of a stilling well and potentiometer based shaft encoder. It is a low-power option for reading the water level of an evaporation pan such as the 255-200.

The 255-100 consists of a chain-mounted float and counter weight that turns a sprocket attached to a precision 1000 ohm potentiometer. When provided with a precision excitation from the datalogger, the NovaLynx 255-100 Evaporation Gauge produces a DC voltage that changes proportionally to the change in water depth of the evaporation pan. The datalogger measures the voltage to determine water level and, consequently, evaporation and rainfall. Using the 255-100P/F Steel Pipe & Fittings, the gauge may be installed outside of, but hydraulically connected to the pan. This configuration will prevent the gauge from interfering with the wind flow over the pan or from altering the solar loading on the pan. A pipe connects the pan to the gauge keeping both at the same "head".

Evaporation pans need to be refilled from time to time. Depending on the local rainfall, the pan should be filled to about 2 to 3 inches below the top. The evaporation pan can be refilled automatically with the 255-620 Automatic Refill Kit. More precise refill control can be done by programming the datalogger to control a solenoid valve. Programming the datalogger for partially draining the evaporation pan, using a second solenoid valve, may be desirable if the site regularly experiences heavy rainstorms. Refer to the section on Automatically Refilling the Evaporation Pan in this document for more information.

NOTE Fences or other deterrents are required to prevent animals from using the evaporation pan as a watering trough.

2. Specifications

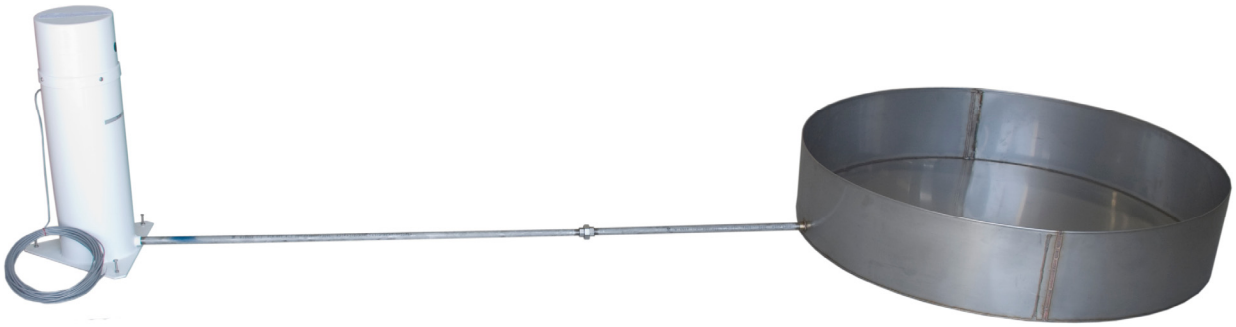

FIGURE 1. 255-100 Connected to 255-200 Using 255-100P/F

255-100 Novalynx Analog Output Evaporation Gauge

Height:	27 1/2” (700 mm)
Diameter:	8” (203 mm)
Weight:	7 1/2 lbs (3.4 kg)
Shipping weight:	15 lbs (6.8 kg)
Cable:	50' of 3-conductor, 24 AWG, shielded
Float:	4” diameter, plastic
Counterweight:	4 oz (114 g), stainless steel
Water input port:	1/2” NPT coupling, female
Base dimensions:	16” (40.6 cm) triangle with leveling screws
Total resolution:	0.03” (0.76 mm)
Accuracy:	0.25%
Rotation:	360° continuous
Electrical angle:	340°, ±1° (20° gap)
Resistance:	1,000 ohms, ±10%
Operating temperature:	-40° to +60°C
Linearity:	0.25%
Mechanical range:	0 to 10” (0 – 254 mm)
Electrical range:	0 to 9.44” (0 – 240 mm)

FIGURE 2. 255-100 Novalynx Analog Output Evaporation Gauge

255-200 Novalynx Class A Evaporation Pan

Material:	Low carbon stainless steel, type 304, 18 gauge
Construction:	Heliarc welded, 1/2” drain plug NPT female coupling
Size:	10” deep x 47-1/2” diameter (25.4 cm x 120.7 cm)
Volume:	Approximately 77 gallons (291 liters)
Weight:	48 lbs (21.8 kg)
Shipping weight:	59 lbs (26.8 kg)

FIGURE 3. 255-200 Novalynx Class A Evaporation Pan

255-100P/F Novalynx Stainless Steel Pipe and Fittings for Evaporation Pan

Pipe fittings for 255-100, made of stainless steel

Weight:	12 lb (5.4 kg)
Dimensions:	3” x 3” x 60” (7.6 cm x 7.6 cm x 152.4 cm)

FIGURE 4. 255-100P/F Novalynx Stainless Steel Pipe and Fittings for Evaporation Pan

It is recommended that all international customers purchase this accessory, as pipe of the right diameter may be difficult to locate in their country.

NOTE Instead of using this, you can use 1/2” polybraid (fiber reinforced) flexible tubing, nylon fittings (1/2” NPT x Hose Bar), and small stainless steel hose clamps; this equipment is available from a local hardware store.

NovaLynx Model 255-250 Evaporation Pan Support Platform (Available by Special Order)
Wood platform for supporting the evaporation pan
Weight: 30 lb (13.6 kg)
Dimensions: 50” x 50” x 10” (127 cm x 127 cm x 25.4 cm)

NOTE This can easily be built by using the NovaLynx sketch, or a wood pallet of these dimensions might be available locally.

3. Installation

Please refer to the NovaLynx instruction manual Section 3.

4. Wiring

The evaporation gauge connects to the datalogger as shown in Figure 5.

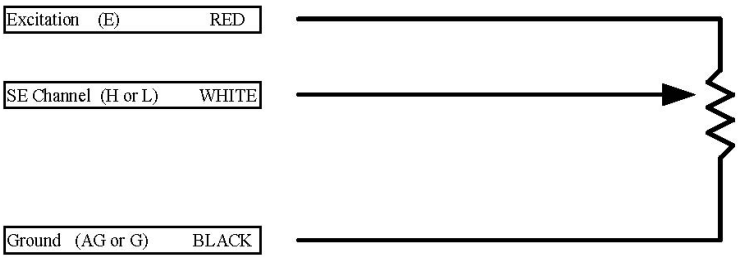

FIGURE 5. 255-100 Schematic

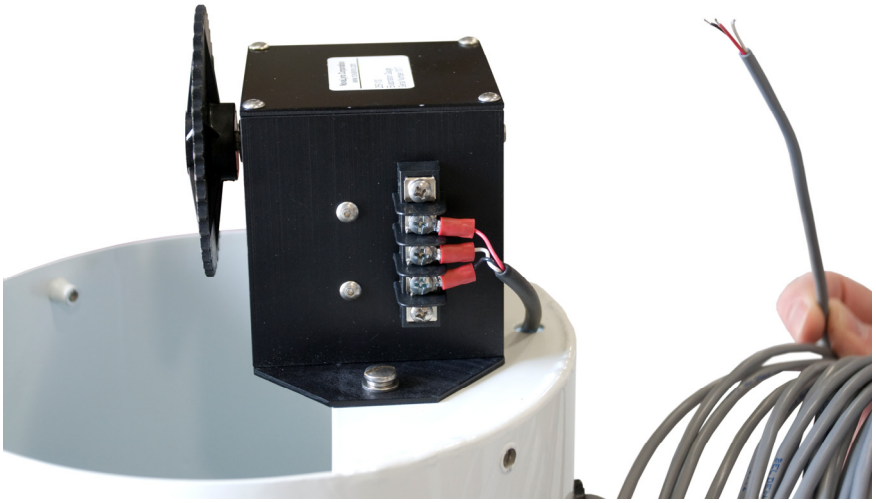

FIGURE 6. Close-up of Terminal Strip on 255-100

5. Programming

Depending on the model of datalogger, make the measurement using the Excite-Delay SE (P4) Edlog instruction, ExDelSE CR200 Series instruction, or the BrHalf CRBasic instruction. An example from each language follows. Multiplier and offset will depend on the calibration of the gauge. These examples are for those who wish write their own program. The Short Cut program generator can be used to create a program by choosing a Generic Measurements>Half Bridge as the sensor.

Wiring Used in Examples

	CR10X	CR200	CR1000
Red	E1	Vx1	Vx1
White	SE1	SE1	SE1
Black	AG	⏚	⏚
Shield	AG	⏚	⏚

CR1000 Measurement Instruction

```
BrHalf (PanLevel,1,mV2500,1,Vx1,1,2500,True,0,_60Hz,1.0,0)
```

CR200-series Measurement Instruction

```
ExDelSE (PanLevel,1,1,Ex1,mV2500,500,1.0,0)
```

CR10X Measurement Instruction

```
01:  Excite-Delay, SE (P4)
   1:   1            Reps
   2:   5            ±2500 mV Slow Range
   3:   1            SE Channel
   4:   1            Excite all reps w/Exchan 1
   5:   1            Delay (units 0.01 sec)
   6:   2500         mV Excitation
   7:   1            Loc [ Level_1  ]
   8:   1.0          Mult
   9:   0.0          Offset
```

CR1000 Example Program

```
'CR1000 Series Datalogger
'Example program for 255-100 Novalynx evaporation gauge
Public PTemp, batt_volt
Public PanLevel
Dim  Leveltemp(5)
Const PanMultiplier = 1                    'Adjust Pan Multiplier and PanOffset
Const PanOffset = 0                        'according to sensor calibration

Units PanLevel = Inches
```

```
DataTable (Hourly,1,-1)
   DataInterval (0,60,min,10)
   Sample (1,PanLevel,FP2)
   Minimum (1,batt_volt,FP2,0,False)
   Sample (1,PTemp,FP2)
EndTable

BeginProg
   Scan (60,Sec,0,0)
      PanelTemp (PTemp,250)
      Battery (Batt_volt)
      'Make five measurements then average the readings to reduce error from ripples in the water
      BrHalf (Leveltemp(),5,mV2500,-1,Vx1,5,2500,True ,20000,_60Hz,PanMultiplier,PanOffset)
      AvgSpa (PanLevel,5,Leveltemp(1))
      'Call data tables
      CallTable Hourly
   NextScan
EndProg
```

CR200-series Example Program

```
'CR200 Program to measure 255-100 Evaporation Gauge
Public Batt_volt
Public PanLevel
Const PanMultiplier = 1                    'Adjust Pan Multiplier and PanOffset
Const PanOffset = 0                        'according to sensor calibration

DataTable (Hourly,1,-1)
   DataInterval (0,60,min)
   Sample (1,PanLevel)
   Minimum (1,Batt_volt,0,0)
EndTable

BeginProg
   Scan (60,Sec)
      Battery (Batt_volt)
      ExDelSE (PanLevel,1,1,Ex1,mV2500,500,PanMultiplier,PanOffset)
      CallTable Hourly
   NextScan
EndProg
```

CR10X Example Program

```
;This CR10X program averages five measurements that occur 0.1 seconds apart to minimize noise
;caused by waves in the stilling well.

01:  If time is (P92)
   1:   0            Minutes (Seconds --) into a
   2:   60           Interval (same units as above)
   3:   30           Then Do
```

```
02:  Beginning of Loop (P87)
   1:   0              Delay
   2:   5              Loop Count

03:  Excite-Delay, SE (P4)
   1:   1              Reps
   2:   5              ±2500 mV Slow Range
   3:   1              SE Channel
   4:   1              Excite all reps w/Exchan 1
   5:   1              Delay (units 0.01 sec)
   6:   2500           mV Excitation
   7:   21         --  Loc [ Level_1  ]
   **8:1.0             Mult
   **9:0.0             Offset

;It is important the Location is indexed (--).

04:  Excitation with Delay (P22)
   1:   1              Ex Channel
   2:   0              Delay W/Ex (units = 0.01 sec)
   3:   10             Delay After Ex (units = 0.01 sec)
   4:   0              mV Excitation

05:  End (P95)

06:  Spatial Average (P51)
   1:   5              Swath
   2:   21             First Loc [ Level_1  ]
   3:   1              Avg Loc [ AveReps1  ]

07:  End (P95)

** Use a multiplier of 1.0 and an offset of 0.0 to calibrate, then substitute the appropriate multiplier
and offset (for more information, see the Steps for Calibrating section).
```

6. Calibration

All 255-100 gauges need to be field calibrated by the user. Field calibration will provide the multiplier and offset for use in the datalogger program to provide data in units of inches or centimeters. The CRBasic FieldCal instruction may be used to perform the calculations automatically and preserve the results in the datalogger. Refer to the FieldCal help in CRBasic Editor for more information on its use. The following provides instructions on performing a manual field calibration.

Steps for Calibrating

(1) Fill the evaporation pan to a depth, measure with a ruler. Depth of water in the evaporation gauge may be different than in the pan, but will be at the same level (elevation).

(2) Measure the voltage using the gauge and datalogger Instruction 4, ExDelSE or BrHalf with a multiplier of 1.0 and an offset of 0.0.

(3) Add more water to the evaporation pan and measure the water's depth in the pan.

(4) Measure the voltage at that depth using the gauge and datalogger Instruction 4, ExDelSE or BrHalf with a multiplier of 1.0 and an offset of 0.0.

(5) Calculate the multiplier and offset using the method described in Section 5 of the NovaLynx instruction manual.

Example

This example calculates the multiplier (m) and offset (b) for a specific evaporation gauge. Because the multiplier and offset vary with each gauge, your numbers will be different than this example. In this example the pan is filled to a depth of 2" and the datalogger reads 100 mV on the gauge. The pan is then filled to a depth of 8" and the datalogger reads 2100 mV. This provides data for a two point calibration.

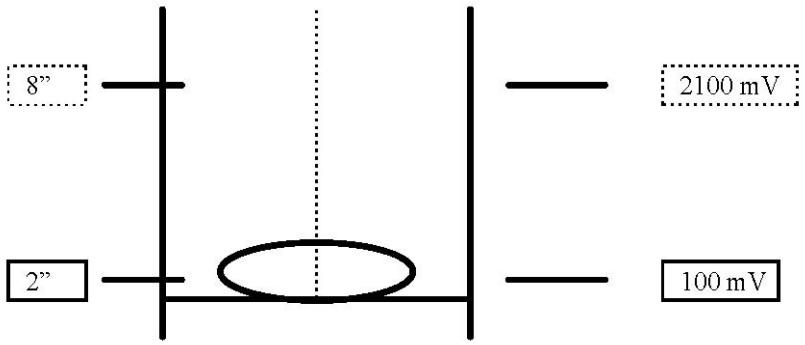

FIGURE 7. Determining the Multiplier and Offset for an Evaporation Gauge

Measurement instructions use the following formula when applying multiplier and offset to readings:

Y = mX + b Where 'm' is the multiplier, 'b' is the offset, 'X' is the raw reading, and 'Y' is the output
(X1, Y1) = (100 mV, 2")
(X2 , Y2) = (2100 mV, 8")
m = (8" - 2") / (2100 mV - 100 mV) = *0.003"/mV Multiplier*
b = Y1 - mX1 = 2" - (0.003" * 100 mV) = *1.7" Offset*

7. Automatically Refilling the Evaporation Pan

A simple solution for automatic refilling of the evaporation pan is provided by the 255-620 Evaporation Pan Automatic Refill System. The 255-620 consists of an Electronic Water Timer powered by 2 'AAA' batteries and an Automatic Float Valve. The 255-620 must be connected to a user-provided water supply. The water supply can be a pressurized system or a storage tank that sits higher than the evaporation pan. The Automatic Float Valve will stop tank filling

between 8 1/2" and 9 1/2" (depending on water pressure). The Electronic Water Timer will enable tank filling at a user set time and interval.

If more precise fill control is wanted, program the datalogger to control a solenoid valve in a fill line that's connected to a water supply. A second solenoid may be used for draining the pan in areas of high rainfall. Power requirements need to be taken into consideration when using a solenoid valve.

8. Recommended Solenoids

Solenoid for clean water only — ASCO p.n. 8210G94

A 1/2", 12 VDC solenoid.

Solenoid for acidic water — ASCO p.n. SC827012E

A 1/2" 12 VDC solenoid with a plastic valve that can handle up to 40% sulfuric acid. Acidic water also requires plastic pipes.

Use 1/2 inch inside diameter NPT fittings. Mount the solenoid next to the tank (0 psi) or next to the pan (1 psi). Use a solenoid that requires 0 psi differential pressure.

NOTE The solenoid cannot be powered by the switched 12 volts of the datalogger. CSI part number 7321 Crydom Relay is recommended for this purpose. Mount this in the enclosure and run the control voltages and lines (+12 V and ground) out to the solenoid.

NOTE It is highly recommended that the solenoids valves have a power supply independent of the weather station. If the fill tank runs dry, the solenoid could remain open for an extended period draining the battery.

9. Storage Tank Size

If a storage tank is used, you need to determine the best size of tank for your application. You determine this by estimating the amount of water you'll use and deciding the number of trips to refill the tank you're willing to make. You can estimate the amount of water you'll use by multiplying the pan's surface area by the evaporation rate of the worst case condition (i.e., a hot dry summer day).

Example

If you're using a 48 inch diameter evaporation pan, the surface area is:

$\pi R^2 = \pi(24")^2$

$= 1{,}809.56 \text{ in}^2$ or $11{,}674.56 \text{ cm}^2$

Assuming you refill the pan once a day and the evaporation rate is 10 mm (1 cm) per day, the amount of water you'll use is:

(1 cm/day)(11,674.56 cm^2) = 11,674.56 cm^3/day or

11.675 liters/day or 3.1 gallons/day

If you use a 125 gallon tank, you will need to refill the tank in approximately:

(125 gallons)/(3.1 gallons/day) » 40 days

10. Installation and Maintenance

For details on site selection, installation, and maintenance refer to the Cooperative Station Observations section of the National Weather Service Observing Handbook No. 2 currently available at:

http://www.nws.noaa.gov/om/coop/Publications/coophandbook2.pdf

Information is also provided in the instruction manual from Novalynx that comes with the 255-200.

http://www.novalynx.com/

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