App. Note Code: 2RA-F

APPLICATION NOTE

Interfacing Kipp and Zonen's CSD1 with Campbell Scientific Dataloggers

CAMPBELL SCIENTIFIC, INC.
815 W. 1800 N. • Logan, Utah 84321-1784 • (435) 753-2342 • FAX (435) 750-9540

Interfacing Kipp and Zonen's CSD1 with Campbell Scientific Dataloggers

The CSD1 is a sunshine duration meter that is manufactured and sold by Kipp and Zonen. This application note provides a wiring diagram of the connections between the CSD1 and a CSI datalogger and describes programming a datalogger to read the CSD1. The CSD1 is often used as a replacement for the Campbell-Stokes sunshine duration meter.

General

The CSD1 outputs two differentially measured signals, sunshine duration and direct solar radiation. Sunshine duration is typically the desired measurement. Measurement of the direct radiation output is optional, but is recommended. The sunshine duration signal is 1 Vdc when the direct solar radiation is ≥ 120 W m^{-2} and about 20 mV when the direct solar radiation is < 120 W m^{-2}. The direct radiation signal ranges from 0 to 1.0 Vdc which corresponds with 0 to 1000 W m^{-2} of direct solar radiation. The direct radiation signal has an offset or a minimum output of about 4 W m^{-2}. The datalogger can remove this offset by setting radiation measurements that are < 5 W m^{-2} to 0 W m^{-2}.

Wiring

Two differential channels are used to measure the CSD1. Differential measurements reduce the risk of voltage offsets due to current flow through the analog ground back to power ground.

Datalogger	CSD1	Description
+12 Vdc	Brown	Power
G	Yellow	Power Ground
1H	Red	Sunshine Duration Signal
1L	Blue	Signal Reference
2H	Gray	Direct Radiation Signal
2L	Jumper to 1L	Signal Reference

NOTE

The assignment of channel (e.g., diff. channel 1) may vary depending on the application.

Heater

The Campbell-Stokes meters do not have heaters to evaporate dew or frost from the body of the sensor. The CSD1 has both a 1 W and a 10 W heater. The CSD1 draws < 1 mA when heaters are not connected, 80 mA when the 1 W heater is connected and 745 mA when the 10 W heater is connected. To protect the datalogger's power supply, the heater should have a separate power supply.

Heater's Power Supply	CSD1	Description
+12 Vdc	White	Power; only connect when using the 10 watt heater
G	Black	Ground; connect when using a heater
+12 Vdc	Green	Power; only connect when using the 1 watt heater

Program Example

This is a CR10X or CR510 program that measures and displays at one minute intervals, the daily running total of direct sunshine in both minutes and Langleys. Hourly and daily totals of sunshine are also provided. Because the direct radiation signal has an offset of 4 W m^{-2} the program sets radiation measurements that are < 5 W m^{-2} to 0 W m^{-2}.

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*Table 1 Program
  01:    60         Execution Interval (seconds)

;Measure sunshine duration
1:  Volt (Diff) (P2)
  1:      1         Reps
  2:     25         2500 mV 60 Hz Rejection Range
  3:      1         DIFF Channel
  4:      3         Loc [ Sun_Shine ]
  5:      1.0       Mult ;Outputs 1000mV if more than 120
                    W/m2, 0mV if < 120 W/m2
  6:      0.0       Offset

;Following increments the "number of minutes of sunshine"
counter if > 120 W/m2 (900mV)
2:  If (X<=>F) (P89)
  1:      3         X Loc [ Sun_Shine ]
  2:      3         >=
  3:    900         F
  4:     30         Then Do
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3:  Z=Z+1 (P32)
 1:        1         Z Loc [ Min_sun   ]

4:  End (P95)

;Measure direct solar radiation
5:  Volt (Diff) (P2)
 1:        1         Reps
 2:       25         2500 mV 60 Hz Rejection Range
 3:        2         DIFF Channel
 4:        4         Loc [ Dir_Rad_w ]
 5:        1.0       Mult        ;Outputs 0-1000mV corresponding
                                 to 0-1000 W/m2
 6:        0.0       Offset

6:  If (X<=>F) (P89)
 1:        4         X Loc [ Dir_Rad_w ]
 2:        4         <
 3:        5         F           ;If direct solar still increases during
                                 the night,
 4:       30         Then Do     ;then set this value to just above the
                                 night time reading

7:  Z=F (P30)
 1:        0.0       F
 2:       00         Exponent of 10
 3:        4         Z Loc [ Dir_Rad_w ]

8:  End (P95)

;Following converts the 1 minute measurement of direct radiation
in W/m2 into Langleys that can be totalized
;(X W/m2) (J/sW) (1 cal/4.186 J) (1 m2/10000 cm2) (60 s) = X
cal/cm2
9:  Z=F (P30)
 1:        1.4333    F
 2:        3      -- Exponent of 10 (negative or 0.0014333)
 3:        5         Z Loc [ Conv_fact ]

10:  Z=X*Y (P36)
 1:        4         X Loc [ Dir_Rad_w ]
 2:        5         Y Loc [ Conv_fact ]
 3:        6         Z Loc [ DirRad_ly ]
```


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;Following totalizes the Langleys
11:  Z=X+Y (P33)
  1:        6          X Loc [ DirRad_ly ]
  2:        2          Y Loc [ TotRad_ly ]
  3:        2          Z Loc [ TotRad_ly ]

;Output one minute data to final memory
12:  If time is (P92)
  1:        0          Minutes (Seconds --) into a
  2:        1          Interval (same units as above)
  3:       10          Set Output Flag High (Flag 0)

13:  Set Active Storage Area (P80)
  1:        1          Final Storage Area 1
  2:      111          Array ID

14:  Real Time (P77)
  1:     1220          Year,Day,Hour/Minute (midnight = 2400)

15:  Sample (P70)
  1:        1          Reps
  2:        1          Loc [ Min_sun   ]

16:  Sample (P70)
  1:        1          Reps
  2:        2          Loc [ TotRad_ly ]

;Output hourly data to final memory
17:  If time is (P92)
  1:        0          Minutes (Seconds --) into a
  2:       60          Interval (same units as above)
  3:       10          Set Output Flag High (Flag 0)

18:  Set Active Storage Area (P80)
  1:        1          Final Storage Area 1
  2:      222          Array ID

19:  Real Time (P77)
  1:     1220          Year,Day,Hour/Minute (midnight = 2400)

20:  Sample (P70)
  1:        1          Reps
  2:        1          Loc [ Min_sun   ]
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```
21:  Sample (P70)
  1:        1           Reps
  2:        2           Loc [ TotRad_ly ]

;Output daily data to final memory
22:  If time is (P92)
  1:        0           Minutes (Seconds --) into a
  2:   1440           Interval (same units as above) ;
  3:       10           Set Output Flag High (Flag 0)

23:  Set Active Storage Area (P80)
  1:        1           Final Storage Area 1
  2:     333           Array ID

24:  Real Time (P77)
  1:   1220           Year,Day,Hour/Minute (midnight = 2400)

25:  Sample (P70)
  1:        1           Reps
  2:        1           Loc [ Min_sun    ]

26:  Sample (P70)
  1:        1           Reps
  2:        2           Loc [ TotRad_ly ]

;Zero the accumulations at midnight
27:  If Flag/Port (P91)
  1:       10           Do if Output Flag is High (Flag 0)
  2:       30           Then Do

28:  Z=F (P30)
  1:        0.0         F
  2:       00           Exponent of 10
  3:        1           Z Loc [ Min_sun    ]

29:  Z=F (P30)
  1:        0.0         F
  2:       00           Exponent of 10
  3:        2           Z Loc [ TotRad_ly ]

30:  End (P95)
```

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*Table 2 Program
  02:      0.0000   Execution Interval (seconds)

*Table 3 Subroutines

End Program

1      [ Min_sun   ]  RW--   3       2      ----- ------ ---
2      [ TotRad_ly ]  RW--   4       2      ----- ------ ---
3      [ Sun_Shine ]  RW--   1       1      ----- ------ ---
4      [ Dir_Rad_w ]  RW--   2       2      ----- ------ ---
5      [ Conv_fact ]  RW--   1       1      ----- ------ ---
6      [ DirRad_ly ]  RW--   1       1      ----- ------ ---
7      [ _________ ]  ----   0       0      ----- ------ ---
```