### E.5.1 Sample Program – Basic Wind Site

```
;{CR10X}                                ;Data logger type (CR10X)
;Station Information
;          Name
;          Number or ID
;          Elevation
;          History
;
;Program History
;          Date of implementation
;          Dates of revisions
;-----------------------------------------------------------Begin Wiring Diagram
;Sensor #1: CS500 Relative Humidity and Temperature Probe
;CS500 Black = 1H
;CS500 Brown = 1L
;CS500 Red = 12V
;CS500 Green = G
;CS500 Clear = G
;
;Sensor #2: 05103 Wind Monitor
;05103 SHIELD Clear = G
;05103 WSREF  Black = G
;05103 WDREF  Brown = AG
;05103 WDSIG  Red   = 2H
;05103 WDEXC  Green = E1
;05103 WSSIG  White = P1
;-------------------------------------------------------------End Wiring Diagram

;-------------------------------------------------------------Begin Program
*Table 1 Program
01: 5  Execution Interval (seconds)    ;Measurements are taken every 5 sec

1:  Batt Voltage (P10)
 1: 1       Loc [ Battery ]            ;Sample Battery Voltage

2:  Internal Temperature (P17)         ;Sample the internal temperature
 1: 8       Loc [ IntTemp ]            ;Note: This is recorded for diagnostic purposes and is
                                       ;not used in the program or output to the data file.

3:  Volts (SE) (P1)                    ;Sample air temperature in degrees C.
 1: 1       Reps
 2: 25      2500 mV 60 Hz Rejection Range
 3: 1       SE Channel
 4: 2       Loc [ AIR_TEMP ]           ;See section F.4.2 for conversion to Fahrenheit.
 5: .1      Mult
 6: -40     Offset

4:  Volts (SE) (P1)                    ;Sample relative humidity in %
 1: 1       Reps
 2: 25      2500 mV 60 Hz Rejection Range
 3: 2       SE Channel
 4: 3       Loc [ RH ]
 5: .1      Mult
 6: 0.0     Offset

;-------------------------------------------------------------Begin RH Error Check
;                   Note: automated error checks can mask measurement errors and hinder
;                   sensor diagnostics
5:  IF (X<=>F) (P89)                   ;Check to see if the relative humidity is
 1: 3       X Loc [ RH ]               ;greater than or equal to 100%. If it is, then perform
 2: 3       >=                         ;command number 6.
 3: 100     F
 4: 30      Then Do

6:  Z=F (P30)                          ;Set the relative humidity to 100%.
 1: 100     F
 2: 0       Exponent of 10
 3: 3       Z Loc [ RH ]

7:  End (P95)                          ;End of IF statement.
;-------------------------------------------------------------End of RH Error Check

8:  Excite-Delay (SE) (P4)             ;Sample wind direction in degrees.
 1: 1       Reps
 2: 5       2500 mV Slow Range
 3: 3       SE Channel
 4: 1       Excite all reps w/Exchan 1
 5: 2       Delay (units 0.01 sec)
 6: 2500    mV Excitation
 7: 4       Loc [ WIND_DIR_ ]
 8: .142    Mult
 9: 0       Offset

9:  Pulse (P3)                         ;Sample wind speed in meters/second.
 1: 1       Reps
 2: 1       Pulse Input Channel
 3: 21      Low Level AC, Output Hz
 4: 5       Loc [ WIND_SPD ]
 5: .0980   Mult                       ;For miles/hour use a multiplier of 0.2192. Always
 6: 0       Offset                     ;check instrument documentation for multiplier
                                       ;values.
;-------------------------------------------------------------Begin Data Output Section
;-------------------------------------------------------------15 Minute Data
10:  If time is (P92)                  ;Write to output file every 15 min.
 1: 0       Minutes (Seconds --) into a
 2: 15      Interval (same units as above)
 3: 10      Set Output Flag High

11:  Set Active Storage Area (P80)     ;Place 15 min data in storage area
 1: 2       Final Storage Area 2       ;number two.
```

```
  2: 100     Array ID                          ;Lines containing 15 min data will
                                               ;begin with the array ID 100.

 12:  Real Time (P77)                          ;Time format: 2003,1,0950
  1: 1110    Year, Day, Hour/Minute            ;Year, Day of year, Hour min

 13:  Sample (P70)                             ;Output instantaneous battery
  1: 1       Reps                              ;voltage.
  2: 1       Loc [ Battery ]

 14:  Average (P71)                            ;Output 15 min average of air
  1: 1       Reps                              ;temperature.
  2: 2       Loc [ AIRTEMP ]

 15:  Average (P71)                            ;Output 15 min average of relative
  1: 1       Reps                              ;humidity.
  2: 3       Loc [ RH ]

 16:  Wind Vector (P69)                        ;Output 15 min average of wind
  1: 1       Reps                              ;speed and vector averaged wind
  2: 0       Samples per Sub-Interval          ;direction.
  3: 1       S, θ1 Polar
  4: 5       Wind Speed/East Loc [ WIND_SPD ]
  5: 4       Wind Direction/North Loc [ WIND_DIR_ ]

 17:  Maximize (P73)                           ;Output maximum wind speed in
  1: 1       Reps                              ;the 15 minute period.
  2: 0       Value Only
  3: 5       Loc [ WIND_SPD ]

 18:  Serial Out (P96)                         ;Store data to storage module.
  1: 71      SM192/SM716/CSM1

;-----------------------------------------------------------------Hourly Data

 19:  If time is (P92)                         ;Write to output file every hour.
  1: 0       Minutes (Seconds --) into a
  2: 60      Interval (same units as above)
  3: 10      Set Output Flag High

 20:  Set Active Storage Area (P80)            ;Place hourly data in storage area
  1: 1       Final Storage Area 1              ;number one.
  21: 101    Array ID                          ;Lines containing 15 min data will
                                               ;begin with the array ID 100.

 22:  Real Time (P77)                          ;Time format: 2003,1,0950
  1: 1110    Year, Day, Hour/Minute            ;Year, Day of year, hour min

 13:  Sample (P70)                             ;Output instantaneous battery
  1: 1       Reps                              ;voltage.
  2: 1       Loc [ Battery ]

 23:  Average (P71)                            ;Output hourly average of air temperature.
  1: 1       Reps
  2: 2       Loc [ AIRTEMP ]

 24:  Average (P71)                            ;Output hourly average of relative
  1: 1       Reps                              ;humidity.
  2: 3       Loc [ RH ]

 25:  Wind Vector (P69)                        ;Output hourly average of wind
  1: 1       Reps                              ;speed and vector averaged wind
  2: 0       Samples per Sub-Interval          ;direction.
  3: 1       S, θ1 Polar
  4: 5       Wind Speed/East Loc [ WIND_SPD ]
  5: 4       Wind Direction/North Loc [ WIND_DIR_ ]

 26:  Maximize (P73)                           ;Output maximum wind speed in
  1: 1       Reps                              ;the 1 hour period.
  2: 0       Value Only
  3: 5       Loc [ WIND_SPD ]

 27:  Serial Out (P96)                         ;Store data to storage module.
  1: 71      SM192/SM716/CSM1

End Program
```

*Program Output*

```
        Final Storage Location 1
                101,2003,1,0800,12.42,5.24,68.45,8.34,270,15.93
                101,2003,1,0900,12.40,7.45,60.34,4.72,275,8.30
        Final Storage Location 2
                100,2003,1,0800,12.42,5.69,68.23,8.46,270,14.35
                100,2003,1,0815,12.41,5.94,66.57,7.20,272,12.30
```

### E.5.2 Sample Program – Basic Precipitation Site

```
;{CR10X}
;Station Information
;              Name
;              Number or ID
;              Elevation
;              History
;
;Program History
;              Date of implementation
;              Dates of revisions
;-----------------------------------------------------------Begin Wiring Diagram

;Sensor #1 Judd Communication Depth Sensor, Interval
;Clear = G
;Black = G
;Red   = 12V
;Green = C1
;White = 1H
;Brown = G
;
;Sensor #2 Judd Communication Depth Sensor, Total
;Clear = G
;Black = G
;Red   = 12V
;Green = C1
;White = 1L
;Brown = G
;
;Sensor #3: ETI Precipitation Gauge
;Red   = 12V
;Black = G
;Green = P2
;
;-------------------------------------------------------------End Wiring Diagram
*Table 1 Program
 01: 5        Execution Interval (seconds)          ;Measurements are taken every 5 seconds.

1:  Batt Voltage (P10)                             ;Sample battery voltage.
 1: 1        Loc [ Battery  ]

2:  Pulse (P3)                                     ;Sample precipitation from ETI gauge.
 1: 1        Reps
 2: 2        Pulse Input Channel
 3: 2        Switch Closure
 4: 8        Loc [ PRECIP    ]
 5: .01      Mult
 6: 0        Offset

;-----------------------------------------------------------Begin Depth Sensor Call
;-----------------------------------------------------------Begin Depth Sensor Status Check
3:  If time is (P92)                               ;Perform command every 15 minutes.
 1: 0        Minutes (Seconds --) into a
 2: 15       Interval (same units as above)
 3: 30       Then Do

4:  If Flag/Port (P91)                             ;If the depth sensor is on, turn it off.
 1: 11       Do if Flag 1 is High
 2: 21       Set Flag 1 Low

5:  End (P95)
;-----------------------------------------------------------End Depth Sensor Status Check

6:  If Flag/Port (P91)                             ;This command allows for an instantaneous
 1: 11       Do if Flag 1 is High                  ;measurement of the snow depth from a PC
 2: 1        Call Subroutine 1                     ;that is connected to the data logger (press F1).

7:  If time is (P92)                               ;Call subroutine that measures snow depth
 1: 0        Minutes (Seconds --) into a
 2: 15       Interval (same units as above)
 3: 1        Call Subroutine 1

;-----------------------------------------------------------Begin Data Output Section
;-----------------------------------------------------------15 Minute Data
8:  If time is (P92)                               ;Specify 15 minute output interval.
 1: 0        Minutes (Seconds --) into a
 2: 15       Interval (same units as above)
 3: 10       Set Output Flag High

9:  Set Active Storage Area (P80)                  ;Place 15 min data in storage area number two.
 1: 2        Final Storage Area 2
 2: 100      Array ID                              ;Lines containing 15 min data will begin with the
                                                   ;array ID 100.

10:  Real Time (P77)                               ;Time format: 2003,1,0950
 1: 1110     Year, Day, Hour/Minute                ;Year, Day of year, hour min

11:  Sample (P70)                                  ;Output instantaneous battery voltage
 1: 1        Reps
 2: 1        Loc [ Battery   ]

12:    Sample (P70)                                ;Output instantaneous air temperature from
 1: 1        Reps                                  ;the interval depth sensor.
 2: 2        Loc [ DSTemp1   ]
```

```
13:  Sample (P70)                          ;Output instantaneous snow depth from the
 1: 1       Reps                           ;interval depth sensor.
 2: 3       Loc [ IntSnow   ]

14:  Sample (P70)                          ;Output instantaneous snow depth from the
 1: 1       Reps                           ;total snow depth sensor.
 2: 4       Loc [ TotalSnow ]

15:  Totalize (P72)                        ;Output the total liquid precipitation from
 1: 1       Reps                           ;the ETI gauge.
 2: 8       Loc [ PRECIP    ]

16:  Serial Out (P96)                      ;Store data to storage module.
 1: 71      SM192/SM716/CSM1

;-----------------------------------------------------------Hourly Data

17:  If time is (P92)                      ;Specify 60 minute output interval.
 1: 0       Minutes (Seconds --) into a
 2: 60      Interval (same units as above)
 3: 10      Set Output Flag High

18:  Set Active Storage Area (P80)
21: 101     Array ID                       ;Lines containing 15 min data will
                                           ;begin with the array ID 100.

19:  Real Time (P77)                       ;Time format: 2003,1,0950
 1: 1110    Year, Day, Hour/Minute         ;Year, Day of year, hour min

20:  Sample (P70)                          ;Output instantaneous battery voltage.
 1: 1       Reps
 2: 1       Loc [ Battery   ]

21:  Sample (P70)                          ;Output instantaneous air temperature
                                           ;from the interval snow depth sensor.
 1: 1       Reps
 2: 2       Loc [ DSTemp1   ]

22:  Sample (P70)                          ;Output instantaneous snow depth from the
 1: 1       Reps                           ;interval snow depth sensor.
 2: 3       Loc [ IntSnow   ]

23:  Sample (P70)                          ;Output instantaneous snow depth from the
 1: 1       Reps                           ;total snow depth sensor.
 2: 4       Loc [ TotalSnow ]

24:  Totalize (P72)                        ;Output the total liquid precipitation from
 1: 1       Reps                           ;the ETI gauge.
 2: 8       Loc [ PRECIP    ]

25:  Serial Out (P96)                      ;Store data to storage module.
 1: 71      SM192/SM716/CSM1

;-----------------------------------------------------------Begin Snow Depth Subroutine
*Table 3 Subroutines
1:  Beginning of Subroutine (P85)          ;Begin subroutine and label it number 1.
 1: 1       Subroutine 1

2:  Do (P86)                               ;Turn on both snow depth sensors
 1: 41      Set Port 1 High                ;(see wiring diagram).

3:  Excitation with Delay (P22)            ;Wait 0.6 seconds for the sensor to
 1: 1       Ex Channel                     ;measure the air temperature
 2: 60      Delay W/Ex (units = 0.01 sec)
 3: 0       Delay After Ex (units = 0.01 sec)
 4: 0       mV Excitation

4:  Excite-Delay (SE) (P4)                 ;Sample air temperature in degrees C
 1: 1       Reps                           ;from the interval snow depth sensor.
 2: 5       2500 mV Slow Range
 3: 1       SE Channel
 4: 1       Excite all reps w/Exchan 1
 5: 0       Delay (units 0.01 sec)
 6: 0       mV Excitation
 7: 2       Loc [ DSTemp1   ]
 8: .2      Mult
 9: -273    Offset

5:  Excite-Delay (SE) (P4)                 ;Sample air temperature in degrees C
 1: 1       Reps                           ;from the total snow depth sensor.
 2: 5       ñ 2500 mV Slow Range
 3: 2       SE Channel
 4: 1       Excite all reps w/Exchan 1
 5: 0       Delay (units 0.01 sec)
 6: 0       mV Excitation
 7: 7       Loc [ DSTemp2   ]
 8: .2      Mult
 9: -273    Offset

6:  Excitation with Delay (P22)            ;Wait 1.8 seconds for the sensor to make
 1: 1       Ex Channel                     ;10 measurements and perform air
 2: 180     Delay W/Ex (units = 0.01 sec)  ;temperature compensation.
 3: 0       Delay After Ex (units = 0.01 sec)
 4: 0       mV Excitation

7:  Excite-Delay (SE) (P4)                 ;Sample interval snow depth in
                                           ;centimeters.
 1: 1       Reps
 2: 5       2500 mV Slow Range
```

```
 3: 1       SE Channel
 4: 1       Excite all reps w/Exchan 1
 5: 0       Delay (units 0.01 sec)
 6: 0       mV Excitation
 7: 3       Loc [ IntSnow   ]
 8: -0.5  Mult                  ;This value outputs snow depth in centimeters
                                ;Use –0.19685 for inches.
 9: 100  Offset                 ;This number is the distance between the sensor
                                ;and the ground surface in centimeters.

8:  Excite-Delay (SE) (P4)      ;Sample total snow depth in centimeters.
 1: 1       Reps
 2: 5       2500 mV Slow Range
 3: 2       SE Channel
 4: 1       Excite all reps w/Exchan 1
 5: 0       Delay (units 0.01 sec)
 6: 0       mV Excitation
 7: 4       Loc [ TotalSnow ]
 8: -0.5  Mult                  ;This value outputs snow depth in centimeters
                                ;Use –0.19685 for inches.
 9: 1000 Offset                 ;This number is the distance between the sensor
                                ;and the ground surface in centimeters.

9:  Do (P86)                    ;Turn off snow depth sensors.
 1: 51      Set Port 1 Low

10:  End (P95)                  ;End of snow depth subroutine

End Program                     ;End of program
```

*Program Output*

```
        Final Storage Location 1
                101,2003,1,0800,12.42,5.24,8.30,140.34,0.59
                101,2003,1,0900,12.40,7.45,9.53,141.83,0.63
        Final Storage Location 2
                100,2003,1,0800,12.42,5.26,8.30,140.36,0.58
                100,2003,1,0815,12.41,5.94,8.34,140.7,0.59
```

### E.5.2 Sample Program – Temperature Conversion

The air temperature measurements in the program examples are output in degrees kelvin. Within the sampling commands the temperatures are converted from degrees kelvin to degrees Celsius. The commands listed below can be added to any Campbell Scientific program to convert a temperature in degrees Celsius to degrees Fahrenheit.

```
#:  Z=X*F (P37)                 ;Multiply the air temperature in degrees
 1: 2       X Loc [ AIRTEMPF ]  ;C by 1.8 and store it in the same location.
 2: 1.8     F
 3: 2       Z Loc [ AIRTEMPF ]

#:  Z=X+F (P34)                 ;Add 32 to the new value to complete
 1: 2       X Loc [ AIRTEMPF ]  ;the conversion. The temperature
 2: 32      F                   ;in degrees F is stored in the same
 3: 2       Z Loc [ AIRTEMPF ]  ;location.
```