INSTRUCTION MANUAL

Gill Instruments WindSonic Two Dimensional Sonic Anemometer

Revision: 7/10

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Gill Instruments WindSonic Two Dimensional Sonic Anemometer

1. General Description

The WindSonic is an ultrasonic anemometer for measuring wind direction and wind speed. It uses two pairs of orthogonally oriented transducers to sense the horizontal wind. The transducers bounce the ultrasonic signal from a hood, thus minimizing the effects of transducer shadowing and flow distortion. The WindSonic is shipped from Campbell Scientific with a user-specified cable to interface to a Campbell Scientific datalogger and a 34.93 cm (13.75 inch) long vertical mount and right angle bracket to mount the WindSonic to a horizontal boom.

Detailed information on the Gill WindSonic is available in the manual published by Gill Instruments, Ltd. and can be found at www.gill.co.uk/products/anemometer/windsonic.htm. This manual serves as a guide for interfacing the WindSonic to Campbell Scientific dataloggers. The WindSonic is available in two versions. The Option 1 WindSonic (WindSonic1) outputs data using the RS-232 interface. The Option 4 WindSonic (WindSonic4) outputs data using the SDI-12 interface.

The WindSonic1 is interfaced to the Campbell Scientific datalogger via control/serial ports (COMn). This interface is supported by the CR800-series, CR1000, or CR3000 dataloggers. A maximum of four WindSonic1 anemometers can be connected to a single CR1000 or CR3000 datalogger while two can be connected to the CR800-series control ports (COMn). Additional WindSonic1 anemometers can be interfaced using the SDM-SIO1. Campbell Scientific does not recommend using the CR200(X)-series, CR5000, or any of the Edlog dataloggers with the WindSonic1 because of their limited serial support using the control ports.

Campbell Scientific recommends that the WindSonic4, SDI-12 interface, be used with CR200(X)-series, CR510, CR10X, CR23X, or CR5000 dataloggers. SDI-12 is a three-wire digital interface standard used by processor-based sensors and digital recording devices. The CR800-series, CR1000, and CR3000 also support the SDI-12 interface.

A serial cable (WINDSONICRCBL-L) is available for interfacing a WindSonic1 or WindSonic4 to a PC running Gill's PC support software. The cable and software are used during troubleshooting or to change settings in the WindSonic1 for a specific application. A copy of Gill's PC support software is available at www.gill.co.uk/main/software.asp. WindView is used for WindSonics with serial numbers of 0810001 or greater, and WindCom is used for WindSonics with serial numbers that are less than 0810001.

2. Specifications

Wind Direction

Operating Range: 0 to 360 degrees

Accuracy: ± 3 degrees

Output Resolution: 1 degree

Wind Speed

Operating Range: 0 to 60 m/s

Accuracy: ± 2% of reading

Output Resolution: 0.01 m/s

General Specifications

Output Signal: RS-232 (Option 1)
SDI-12 version 1.3 (Option 4); address factory set to 0

Output Variables: wind direction, wind speed, and diagnostic (Option 1 or 4) or u_x, u_y, and diagnostic (Option 4)

Measurement Frequency: 40 Hz block averaged to a programmable output frequency, factory set to 1 Hz

Power: 9 mA (Option 1), 23 mA (Option 4)

Operating Temperature Range: -35ºC to +70ºC

Dimensions: 142 mm diameter (5.6 inches) x 160 mm (6.3 inches)

Weight: 500 g (1.1 lb.)

Campbell Scientific Factory Default Settings for the WindSonic1

Continuous polar wind (M2)

Wind speed in m/s (U1)

Field Formatted, comma delineated values (O2)

Terminate records with a carriage return and line feed (L1)

1 Hz output frequency (P1)

Baud rate – 38400 baud (B5)

No power up message (H2)

Address set to "Q" (NQ)

Data bits and parity – 8 bits, no parity (F1)

RS-232 interface (E3)

Analog output 0 to 5 Vdc (T1) – does not apply

Analogy range 0 to 30 m/s (S4) – does not apply

Analog wrap around 0 to 360 degrees (C2) – does not apply

Minimum direction velocity (K5)

3. Installation

3.1 Siting

Locate the WindSonic away from obstructions, e.g. trees and buildings. As a general rule of thumb, the distance between wind sensors and the nearest obstruction should be ten times the height of the obstruction. If it is necessary to mount the WindSonic on the roof of a building, the height of the sensor, above the roofline, should be at least 1.5 times the height of the building. See Section 11 for a list of references that discuss siting wind direction and speed sensors.

3.2 Mounting

The WindSonic is shipped with a mounting kit (p/n 17387). This kit includes a 34.93 cm (13.75 inch) length of tubing (p/n 17386), three #6-32 x 0.375 inch pan head screws (p/n 505), and a Right Angle Mounting Kit (CM220).

Thread the connector end of the cable through the vertical mount, start at the end without the three threaded holes. Attach the female mating connector on the cable to the male mating connector located on the bottom of the WindSonic. Finally, secure the WindSonic to the vertical mount using the three #6-32 x 0.375 inch pan head screws (p/n 505).

This assembly is attached to either a tripod or tower via a CM202, CM204, CM206, or user-supplied horizontal arm using a CM220 Right Angle Mounting Kit (Figure 1). Orient the WindSonic so that the colored north marker arrows point to True North. Appendix A contains detailed information on determining True North using a compass and the magnetic declination for the site.

FIGURE 1. WindSonic Mounted on a CM202 using p/n 17837

4. Sensor Configuration

In order to best mimic a mechanical anemometer, the WindSonic's output frequency must match the datalogger's scan frequency. The factory setting for the WindSonic1 and WindSonic4 is 1 Hz, e.g 1 output per second. The data output frequency of the WindSonic4 can not be changed.

The data output frequency of the WindSonic1 can be set to five discreet values (see Table 1) using Gill's PC support software and the RS-232 WindSonic to PC cable.

TABLE 1. WindSonic1 Output Frequencies

Output Frequency (Hz)	Seconds Per Output (s)
4	0.25
2	0.5
1	1
0.5	2
0.25	4

5. Wiring

5.1 Serial Wiring (COMn)

CRBasic dataloggers (CR800-series, CR1000, and CR3000) support serial communications with dedicated UART hardware on the datalogger control ports. Two control ports can be configured as a single communications (COMn) port. The WindSonic1 serial interface uses four wires as shown in Table 2.

TABLE 2. WindSonic1 to Datalogger Connections

Description	Color	CRBasic Datalogger
WindSonic RxD	Green	COM*n* Tx
WindSonic TxD	White	COM*n* Rx
Power	Red	12 Vdc
Serial/power reference	Black	G
Shield	Clear	G

NOTE The maximum cable length that can be used with a RS-232 interface depends on the baud rate, the nominal resistance of the wire, the capacitance between conductors, and the capacitance between the conductors and the shield. According to the Electronic Industries Association RS-232D standard, a rough rule of thumb is to limit RS-232 cable lengths to 15.24 m (50 feet) or less at 9600 baud.

Communications between the WindSonic1 and the CRBasic datalogger will most likely fail if the RS-232 cable is extended beyond 50 feet.

5.2 Serial Wiring (SDM-SIO1)

CRBasic dataloggers support serial communications using the SDM-SIO1 peripheral. The SDM-SIO1 converts RS-232 signals into Synchronous Device for Measurements (SDM). SDM is a Campbell Scientific digital communications protocol used between Campbell Scientific dataloggers and SDM peripherals. At a 1 Hz measurement rate, a maximum of 4 WindSonics1 can be measured by a datalogger. Table 3 describes the connections between a WindSonic1 and SDM-SIO1.

TABLE 3. WindSonic1 to SDM-SIO1 Connections

Description	Color	SDM-SIO1
WindSonic RxD	Green	TX-Z
WindSonic TxD	White	RX-A
Power	Red	+12V
Serial/power reference	Black	G
Shield	Clear	G

NOTE The maximum cable length that can be used with a RS-232 interface depends on the baud rate, the nominal resistance of the wire, the capacitance between conductors, and the capacitance between the conductors and the shield. According to the Electronic Industries Association RS-232D standard, a rough rule of thumb is to limit RS-232 cable lengths to 15.24 m (50 feet) or less at 9600 baud.

Communications between the WindSonic1 and the CRBasic datalogger will most likely fail if the RS-232 cable is extended beyond 50 feet.

5.3 SDI-12 Wiring

The WindSonic4 interfaces to a Campbell Scientific datalogger using SDI-12. SDI-12 is a three-wire interface used between processor-based sensors and digital recorders (Table 4). Each SDI-12 sensor has a unique address. The factory-set address for the WindSonic is 0. To change the SDI-12 address, see Section 8 for wiring and programming. At a 1 Hz measurement rate, a maximum of 4 WindSonic4s can be measured by a datalogger.

TABLE 4. WindSonic4 to Datalogger Connections

Description	Color	Datalogger
SDI-12 data	Green	SDI-12 Input or Control Port
SDI-12 power	Red	12 Vdc
SDI-12 reference	Black	G
Shield	Clear	G

NOTE The maximum WindSonic4 SDI-12 cable length test by Gill is 91 m (300 ft). The SDI-12 standard specifies that an SDI-12 sensor must be able to use at least 61 m (200 ft) of signal cable. Greater SDI-12 cable lengths are acceptable.

6. Datalogger Programming for RS-232 Output

A program for the WindSonic1 can be written using a free utility called ShortCut. ShortCut is available on the Campbell Scientific website and can be used to create a user specific data logger program and wiring diagram for the WindSonic1 or WindSonic4. Example 1 is a more sophisticated program than that created by ShortCut, because bad data flagged by the WindSonic is not used in the computation of the wind direction and speed.

The WindSonic1 updates the RS-232 output to a user set frequency. The CRBasic dataloggers (CR800-series, CR1000, and CR3000) use the SerialInRecord () instruction to retrieve the latest record sent by the WindSonic at the scan interval. This ensures that the most current wind data is available for use by the program.

The datalogger and WindSonic each utilize from their own internal clocks. These clocks are not perfectly synchronized with each other and will drift in and out of phase. This phase drift could cause missed samples because no new data was transmitted to the datalogger in time for the next scan. If a new record is not available, the datalogger will use the previous record. The programs written by ShortCut and those in this manual record the number of missed records as no new data (nnd_TOT). A no new data error will occur if the WindSonic is disconnected from the serial port, the WindSonic has no power, or the datalogger and WindSonic clocks have drifted out of phase by one cycle.

Early versions of the CRBasic datalogger Operating System (OS) did not support serial communication using control ports, even though the hardware was available, or the instruction SerialInRecord (). It may be necessary to update the CRBasic datalogger OS. Table 5 lists the OS versions that support both serial communications using control ports and the SerialInRecord (). The most current datalogger operating systems are available on the Campbell Scientific website in the Support|Downloads section.

TABLE 5. CRBasic Datalogger Operating Systems that Support RS-232 Communications and SerialInRecord ().

Datalogger Model	Operating System
CR800-series	4.0 or later
CR1000	13.0 or later
CR3000	6.0 or later

6.1 A WindSonic1 on a CRBasic Datalogger using a COMn Port

TABLE 6. Wiring for Program Example 1

Description	Color	CR1000
WindSonic RxD	Green	COM1 Tx (C1)
WindSonic TxD	White	COM1 Rx (C2)
Power	Red	+12 Vdc
RS-232/Power reference	Black	G
Shield	Clear	G

Example 1. CR1000 Datalogger Program for Measuring a WindSonic1

```
'CR1000 Series Datalogger

Public windsonic(4)
Alias windsonic(1) = wind_direction
Alias windsonic(2) = wind_speed
Alias windsonic(3) = diag
Alias windsonic(4) = nmbr_bytes_rtrnd
Units wind_direction = degrees
Units wind_speed = m/s
Units diag = arb

Dim in_bytes_str As String * 21
Dim checksum_flg As Boolean
Dim disable_flg As Boolean
Dim n
Units n = samples
```

```
DataTable (stats,TRUE,-1)
   DataInterval (0,30,Min,10)

   WindVector (1,wind_speed,wind_direction,IEEE4,disable_flg,0,0,0)
   FieldNames ("mean_wind_speed,mean_wind_direction,std_wind_dir")
   Totalize (1,n,IEEE4,disable_flg)
   FieldNames ("samples_TOT")
   Totalize (1,n,IEEE4,diag<>1)
   FieldNames ("diag_1_TOT")
   Totalize (1,n,IEEE4,diag<>2)
   FieldNames ("diag_2_TOT")
   Totalize (1,n,IEEE4,diag<>4)
   FieldNames ("diag_4_TOT")
   Totalize (1,n,IEEE4,diag<>8)
   FieldNames ("diag_8_TOT")
   Totalize (1,n,IEEE4,diag<>9)
   FieldNames ("diag_9_TOT")
   Totalize (1,n,IEEE4,diag<>10)
   FieldNames ("diag_10_TOT")
   Totalize (1,n,IEEE4,nmbr_bytes_rtrnd<>0)
   FieldNames ("nnd_TOT")
   Totalize (1,n,IEEE4,nmbr_bytes_rtrnd<>0 IMP checksum_flg)
   FieldNames ("checksum_err_TOT")
EndTable

BeginProg
   n = 1
   SerialOpen (Com1,38400,3,0,49)
   Scan (1,Sec,3,0)
      SerialInRecord (Com1,in_bytes_str,&h02,0,&h0D0A,nmbr_bytes_rtrnd,00)
      wind_direction = Mid (in_bytes_str,3,3)
      wind_speed = Mid (in_bytes_str,7,6)
      diag = Mid (in_bytes_str,16,2)
      checksum_flg = ( (HexToDec (Mid (in_bytes_str,20,2))) EQV (CheckSum (in_bytes_str,9,18)) )
      disable_flg = (NOT (checksum_flg) OR (nmbr_bytes_rtrnd=0) OR (diag<>0))

      CallTable stats
   NextScan
EndProg
```

6.2 A WindSonic1 on a CRBasic Datalogger using a SDM-SIO1

TABLE 7. Wiring for Program Example 1

Description	Color	CR1000
WindSonic RxD	Green	TX-Z
WindSonic TxD	White	RX-A
Power	Red	+12 Vdc
RS-232/Power reference	Black	G
Shield	Clear	G

Example 2. CR1000 Datalogger Program
for Measuring a WindSonic1 using a SDM-SI01

```
'CR1000 Series Datalogger

Public windsonic(4)
Alias windsonic(1) = wind_direction
Alias windsonic(2) = wind_speed
Alias windsonic(3) = diag
Alias windsonic(4) = nmbr_bytes_rtrnd
Units wind_direction = degrees
Units wind_speed = m/s
Units diag = unitless

Dim in_bytes_str As String * 21
Dim checksum_flg As Boolean
Dim disable_flg As Boolean
Dim n
Units n = arb


DataTable (stats,TRUE,-1)
   DataInterval (0,30,Min,10)

   WindVector (1,wind_speed,wind_direction,IEEE4,disable_flg,0,0,0)
   FieldNames ("mean_wind_speed,mean_wind_direction,std_wind_dir")
   Totalize (1,n,IEEE4,disable_flg)
   FieldNames ("samples_TOT")
   Totalize (1,n,IEEE4,diag<>1)
   FieldNames ("diag_1_TOT")
   Totalize (1,n,IEEE4,diag<>2)
   FieldNames ("diag_2_TOT")
   Totalize (1,n,IEEE4,diag<>4)
   FieldNames ("diag_4_TOT")
   Totalize (1,n,IEEE4,diag<>8)
   FieldNames ("diag_8_TOT")
   Totalize (1,n,IEEE4,diag<>9)
   FieldNames ("diag_9_TOT")
   Totalize (1,n,IEEE4,diag<>10)
   FieldNames ("diag_10_TOT")
   Totalize (1,n,IEEE4,nmbr_bytes_rtrnd<>0)
   FieldNames ("nnd_TOT")
   Totalize (1,n,IEEE4,nmbr_bytes_rtrnd<>0 IMP checksum_flg)
   FieldNames ("checksum_err_TOT")
EndTable


BeginProg
   n = 1
   SerialOpen (50,38400,3,0,49) ‘SDM-SIO1 SDM address set to 8.
   Scan (1,Sec,3,0)
      'Get data from WindSonic.
      SerialInRecord (50,in_bytes_str,&h02,0,&h0D0A,nmbr_bytes_rtrnd,00)
      wind_direction = Mid (in_bytes_str,3,3)
      wind_speed = Mid (in_bytes_str,7,6)
      diag = Mid (in_bytes_str,16,2)
      checksum_flg = ( (HexToDec (Mid (in_bytes_str,20,2))) EQV (CheckSum (in_bytes_str,9,18)) )
      disable_flg = (NOT (checksum_flg) OR (nmbr_bytes_rtrnd=0) OR (diag<>0))
```

```
    CallTable stats
  NextScan
EndProg
```

7. Datalogger Programming for SDI-12 Output

The WindSonic4 updates the SDI-12 output at a frequency of 1 Hz. The most appropriate SDI-12 command to retrieve data from the WindSonic is the "*a*R*o*!", where *a* is the WindSonic SDI-12 address and *o* is the data format option (Table 7). For dataloggers that do not support the "*a*R*o*!" command, use the "*a*D*o*!".

TABLE 8. WindSonic Data Format Option

Option (o)	Output	Units	Comment
0	wind	degrees	Compass polar coordinate system
	wind speed	m/s	
	diagnostic	unitless	
1	u_x wind	m/s	Orthogonal right hand coordinate system
	u_y wind	m/s	
	diagnostic	unitless	

CAUTION The WindSonic returns three data points; the datalogger program must allocate three consecutive input locations (Edlog datalogger) or a variable array with three elements (CRBasic dataloggers).

When the datalogger issues the "*a*R*o*!" command, the WindSonic immediately begins transmitting the most current wind measurements to the datalogger. After receiving the "*a*R*o*!"command, it takes the WindSonic approximately 190 milliseconds ±10 milliseconds to transmit the data. If the "*a*D*o*!" command is used, it will take slightly longer to retrieve the data because of the additional handshaking required with the "*a*D*o*!" command. For all practical purposes a datalogger can measure up to 4 WindSonic4s at 1 Hz.

Table 8 lists the datalogger OS version and revision that supports the SDI-12 "*a*R*o*!" command. The most current datalogger operating systems are available at the Campbell Scientific website in the Support|Downloads section.

TABLE 9. Datalogger Operating Systems that Support the SDI-12 "*a*R*o*!" Command.	
Datalogger Model	**Operating System**
CR510	1.13 or later
CR510-PB	1.6 or later
CR510-TD	1.13 or later
CR10X	1.20 or later
CR10X-PB	1.6 or later
CR10X-TD	1.12 or later
CR23X	1.17 or later
CR23X-PB	1.6 or later
CR23X-TD	1.12 or later
CR200(X)-series	3.0a or later
CR800-series	1.0 or later
CR1000	1.0 or later
CR3000	1.0 or later
CR5000	1.8 or later

7.1 A WindSonic4 on an Edlog Datalogger

TABLE 10. Wiring for Program Example 3		
Description	**Color**	**CR10X**
SDI-12 data	Green	C8
SDI-12 power	Red	+12 Vdc
SDI-12 reference	Black	G
Shield	Clear	G

Example 3. CR10X (Edlog) Datalogger Program for Measuring a WindSonic4

```
;{CR10X}
;

*Table 1 Program
  01:  1.0000          Execution Interval (seconds)

1:  SDI-12 Recorder (P105)
   1:   0              SDI-12 Address
   2:   20             Continuous Measurements (aR0!)
   3:   8              Port
   4:   1              Loc [ wnd_dir   ]
   5:   1              Mult
   6:   0              Offset

2:  Z=F x 10^n (P30)
   1:   1              F
   2:   0              n, Exponent of 10
   3:   4              Z Loc [ samples   ]

3:  If (X<=>F) (P89)
   1:   1              X Loc [ wnd_dir   ]
   2:   4              <
   3:   -99990         F
   4:   30             Then Do

4:  Block Move (P54)
   1:   2              No. of Values
   2:   1              First Source Loc [ wnd_dir   ]
   3:   1              Source Step
   4:   2              First Destination Loc [ wnd_spd   ]
   5:   1              Destination Step

5:  End (P95)

6:  If time is (P92)
   1:   0              Minutes (Seconds --) into a
   2:   30             Interval (same units as above)
   3:   10             Set Output Flag High (Flag 0)

7:  Real Time (P77)
   1:   110            Day,Hour/Minute (midnight = 0000)

8:  If (X<=>F) (P89)
   1:   3              X Loc [ ws_diag   ]
   2:   2              <>
   3:   0              F
   4:   19             Set Intermed. Proc. Disable Flag High (Flag 9)

9:  Wind Vector (P69)
   1:   1              Reps
   2:   0              Samples per Sub-Interval
   3:   0              S, theta(1), sigma(theta(1)) with polar sensor
   4:   2              Wind Speed/East Loc [ wnd_spd   ]
   5:   1              Wind Direction/North Loc [ wnd_dir   ]
```

```
10:  Totalize (P72)
   1:   1              Reps
   2:   4              Loc [ samples   ]

11:  If (X<=>F) (P89)
   1:   3              X Loc [ ws_diag   ]
   2:   1              =
   3:   1              F
   4:   29             Set Intermed. Proc. Disable Flag Low (Flag 9)

;Report the total of diag = 1.
;
12:  Totalize (P72)
   1:   1              Reps
   2:   4              Loc [ samples   ]

13:  If (X<=>F) (P89)
   1:   3              X Loc [ ws_diag   ]
   2:   1              =
   3:   2              F
   4:   29             Set Intermed. Proc. Disable Flag Low (Flag 9)

;Report the total of diag = 2.
;
14:  Totalize (P72)
   1:   1              Reps
   2:   4              Loc [ samples   ]

15:  If (X<=>F) (P89)
   1:   3              X Loc [ ws_diag   ]
   2:   1              =
   3:   4              F
   4:   29             Set Intermed. Proc. Disable Flag Low (Flag 9)

;Report the total of diag = 4.
;
16:  Totalize (P72)
   1:   1              Reps
   2:   4              Loc [ samples   ]

17:  If (X<=>F) (P89)
   1:   3              X Loc [ ws_diag   ]
   2:   1              =
   3:   8              F
   4:   29             Set Intermed. Proc. Disable Flag Low (Flag 9)

;Report the total of diag = 8.
;
18:  Totalize (P72)
   1:   1              Reps
   2:   4              Loc [ samples   ]
```

```
19:  If (X<=>F) (P89)
   1:   3              X Loc [ ws_diag   ]
   2:   1              =
   3:   9              F
   4:   29             Set Intermed. Proc. Disable Flag Low (Flag 9)

;Report the total of diag = 9.
;
20:  Totalize (P72)
   1:   1              Reps
   2:   4              Loc [ samples   ]

21:  If (X<=>F) (P89)
   1:   3              X Loc [ ws_diag   ]
   2:   1              =
   3:   10             F
   4:   29             Set Intermed. Proc. Disable Flag Low (Flag 9)

;Report the total of diag = 10.
;
22:  Totalize (P72)
   1:   1              Reps
   2:   4              Loc [ samples   ]

23:  If (X<=>F) (P89)
   1:   1              X Loc [ wnd_dir   ]
   2:   4              <
   3:   -99990         F
   4:   29             Set Intermed. Proc. Disable Flag Low (Flag 9)

;Report the total of samples of no wind.
;
24:  Totalize (P72)
   1:   1              Reps
   2:   4              Loc [ samples   ]

25:  Do (P86)
   1:   29             Set Intermed. Proc. Disable Flag Low (Flag 9)

*Table 2 Program
   01:  0.0000         Execution Interval (seconds)

*Table 3 Subroutines

End Program

-Input Locations-
1 wnd_dir
2 wnd_spd
3 ws_diag
4 samples
```

TABLE 11. Wiring for Program Example 4

Description	Color	CR10X
SDI-12 data	Green	C1/SDI-12
SDI-12 power	Red	+12 Vdc
SDI-12 reference	Black	G
Shield	Clear	G

Example 4. CR200(X)-series (CRBasic) Datalogger Program for Measuring a WindSonic4

```
'CR200(X) Series Datalogger

Public windsonic(3)
Alias windsonic(1) = wind_direction
Alias windsonic(2) = wind_speed
Alias windsonic(3) = diag
Units wind_direction = degrees
Units wind_speed = m/s
Units diag = unitless

Dim disable_flag
Dim one
Units one = samples

DataTable (stats,TRUE,-1)
  DataInterval (0,30,Min)

  WindVector (wind_speed,wind_direction,disable_flag,0,0)
  FieldNames ("mean_wnd_spd,mean_wnd_dir,std_wnd_dir")
  Totalize (1,one,disable_flag)
  FieldNames ("n_TOT")
  Totalize (1,one,diag<>1)
  FieldNames ("diag_1_TOT")
  Totalize (1,one,diag<>2)
  FieldNames ("diag_2_TOT")
  Totalize (1,one,diag<>4)
  FieldNames ("diag_4_TOT")
  Totalize (1,one,diag<>8)
  FieldNames ("diag_8_TOT")
  Totalize (1,one,diag<>9)
  FieldNames ("diag_9_TOT")
  Totalize (1,one,diag<>10)
  FieldNames ("diag_10_TOT")
  Totalize (1,one,diag<>NaN)
  FieldNames ("no_data_TOT")
EndTable
```

```
BeginProg
   one = 1
   Scan (1,Sec)
      SDI12Recorder (wind_direction,0R0!,1,0)
      If (wind_direction = NAN ) Then
         wind_speed = NAN
         diag = NAN
      EndIf
      disable_flag = (wind_direction=NAN) OR (diag<>0)

      CallTable stats
   NextScan
EndProg
```

7.2 WindSonic4 on a CRBasic Datalogger

TABLE 12. Wiring for Program Example 5

Description	Color	CR800-series
SDI-12 data	Green	C1
SDI-12 power	Red	+12 Vdc
SDI-12 reference	Black	G
shield	Clear	G

Example 5. CR800-series (CRBasic) Datalogger Program for Measuring One WindSonic4 with Address 0

```
'CR800 Series Datalogger

Public windsonic(3)
Alias windsonic(1) = wind_direction
Alias windsonic(2) = wind_speed
Alias windsonic(3) = diag
Units wind_direction = degrees
Units wind_speed = m/s
Units diag = unitless

Dim disable_flag AS Boolean
Dim one
Units one = samples

DataTable (stats,TRUE,-1)
   DataInterval (0,30,Min,10)

   WindVector (1,wind_speed,wind_direction,IEEE4,disable_flag,0,0,0)
   FieldNames ("mean_wind_speed,mean_wind_direction,std_wind_dir")
   Totalize (1,one,IEEE4,disable_flag)
   FieldNames ("n_TOT")
   Totalize (1,one,IEEE4,diag<>1)
   FieldNames ("diag_1_TOT")
   Totalize (1,one,IEEE4,diag<>2)
```

```
  FieldNames ("diag_2_TOT")
  Totalize (1,one,IEEE4,diag<>4)
  FieldNames ("diag_4_TOT")
  Totalize (1,one,IEEE4,diag<>8)
  FieldNames ("diag_8_TOT")
  Totalize (1,one,IEEE4,diag<>9)
  FieldNames ("diag_9_TOT")
  Totalize (1,one,IEEE4,diag<>10)
  FieldNames ("diag_10_TOT")
  Totalize (1,one,IEEE4,diag<>NAN)
  FieldNames ("nnd_TOT")
EndTable

BeginProg
  one = 1
  Scan (1,Sec,3,0)
    SDI12Recorder (wind_direction,1,0,"R0!",1,0)
    If ( wind_direction = NAN ) Then
      wind_speed = NAN
      diag = NAN
    EndIf
    disable_flag =  (wind_direction=NAN) OR (diag<>0)

    CallTable stats
  NextScan
EndProg
```

8. Changing the SDI-12 Address Using LoggerNet and a Datalogger

Up to ten WindSonic4s or other SDI-12 sensors can be connected to a single datalogger control port. For all practical purposes a datalogger can measure up to 4 WindSonic4 at 1 Hz. Each SDI-12 device must have a unique SDI-12 address between 0 and 9. The factory-set SDI-12 address for the WindSonic4 is 0. The WindSonic4 SDI-12 address is changed in software by issuing the "*a*A*b*!" command, where *a* is the current address and *b* is the new address, to the WindSonic4 over the SDI-12 interface. The current address can be found by issuing the "?!" command.

A computer running LoggerNet can be used to issue any valid SDI-12 command through the datalogger to the WindSonic4. For a complete list of SDI-12 commands supported by the WindSonic4, see Section 11 of the Gill WindSonic manual.

8.1 Array-Based Edlog Dataloggers

- Connect a single WindSonic4 to the datalogger using Control Port *p* as described in Section 4.2, and download a datalogger program that contains the SDI-12 Recorder (Instruction 105) instruction with valid entries for each parameter.
- In the LoggerNet Toolbar, navigate to and activate the Test|Terminal Emulator … menu. The "Terminal Emulator" window will open. In the

Select Device menu, located in the lower left hand side of the window, select the station.

- Click on the Open Terminal button. If communications between the datalogger and PC are successful, the red bar located in the upper left hand side of the window, will turn green.
- Click inside the "Terminal Emulator" window and press the <enter> key until the datalogger responds with the "*" prompt (Figure 2).
- To activate the SDI-12 Transparent Mode, on Control Port *p*, enter *p*X and press the <enter> key. The datalogger will respond with "entering SDI-12". If any invalid SDI-12 command is issued, the datalogger will exit the SDI-12 Transparent Mode.
- To query the WindSonic4 for its current SDI-12 address, enter the command "?!". The WindSonic4 will respond with the current SDI-12 address.
- To change the SDI-12 address, enter the command "*a*A*b*!"; where *a* is the current address from the above step and *b* is the new address. The WindSonic4 will change its address and the datalogger will exit the SDI-12 Transparent Mode.
- To activate the SDI-12 Transparent Mode on Control Port *p*, enter *p*X and press the <enter> key. Verify the new SDI-12 address by entering the "?!" command. The WindSonic4 will respond with the new address.
- To exit the SDI-12 Transparent Mode, enter *.

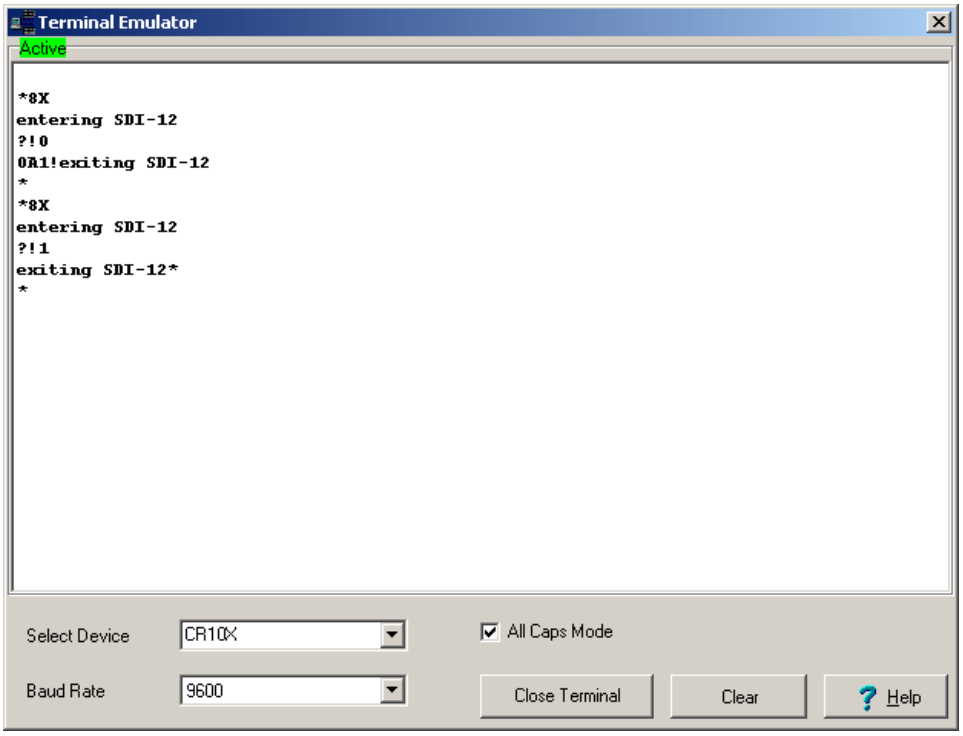


FIGURE 2. Screen Capture of the SDI-12 Transparent Mode on an Edlog Array-Based Datalogger (CR10X) using Control Port 8 and Changing the SDI-12 Address from 0 to 1

8.2 Table-Based Edlog Dataloggers

- Connect a single WindSonic4 to the datalogger Control Port *p* as described in Section 4, and download a datalogger program that contains the SDI-12 Recorder (Instruction 105) instruction with valid entries for each parameter.

- In the LoggerNet Toolbar, navigate to and activate the Test|Terminal Emulator … menu. The "Terminal Emulator" window will open. In the Select Device menu, located in the lower left hand side of the window, select the station.

- Click on the Open Terminal button. If communications between the datalogger and PC are successful, the red bar located in the upper left hand side of the window, will turn green.

- Click inside the "Terminal Emulator" window and press the <enter> key until the TD datalogger responds with the ">" prompt (Figure 3).

- To activate the SDI-12 Transparent Mode, press the <enter> key a few times. The datalogger will respond with a ">" prompt. Enter *# and wait for a datalogger response. It will respond with a "F0000" prompt. Finally, enter *p* (Control Port *p*) and press the <enter> key. The TD datalogger will respond with "entering SDI-12".

- To query the WindSonic for its current SDI-12 address, enter the command "?!". The WindSonic4 will respond with the current SDI-12 address.

- To change the SDI-12 address, enter the command "*a*A*b*!"; where *a* is the current address from the above step and *b* is the new address. The WindSonic4 will change its address and the datalogger will exit the SDI-12 Transparent Mode.

- To activate the SDI-12 Transparent Mode again and check the address change, enter #8 and press the <enter> key. The TD datalogger will respond with "entering SDI-12". Verify the new SDI-12 address by entering the "?!" command. The WindSonic4 will respond with the new address.

- To exit the SDI-12 Transparent Mode, type in ∗ or press the <enter> key.

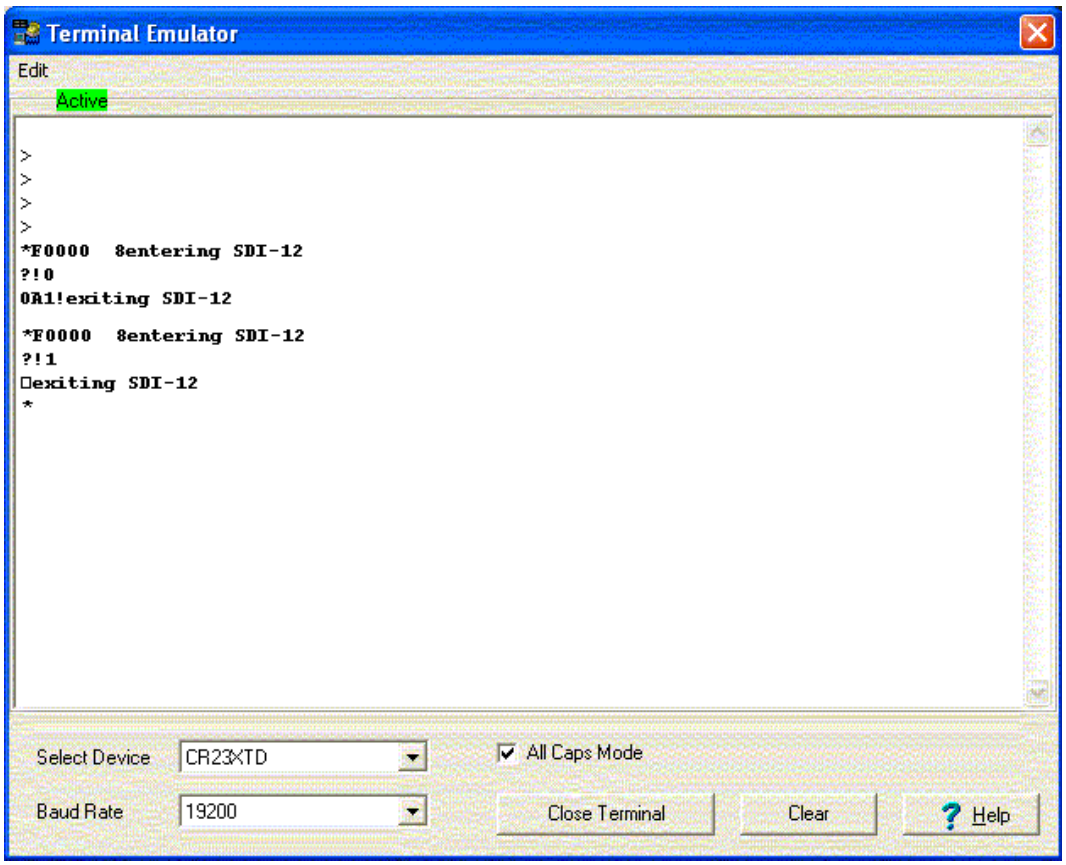


FIGURE 3. Screen Capture of the SDI-12 Transparent Mode on an Edlog Table-Based Datalogger using Control Port 8 and Changing the SDI-12 Address from 0 to 1

8.3 CR200(X)-series Datalogger

- Connect a single WindSonic4 to the datalogger using Control Port C1/SDI12 as described in Section 4, and download a datalogger program that does not contain the SDI12Recorder () instruction.

- In the LoggerNet Toolbar, navigate to and activate the Test|Terminal Emulator … menu. The "Terminal Emulator" window will open. In the Select Device menu, located in the lower left hand side of the window, select the station.

- Click on the Open Terminal button. If communications between the datalogger and PC are successful, the red bar located in the upper left hand side of the window, will turn green.

- Press the <enter> key until the datalogger responds with the "CR200(X)>" prompt (Figure 4).

- To query the WindSonic4 for its current SDI-12 address, press the <enter> key, at the "CR200(X)>" prompt enter the command "SDI12>?!", and press the <enter> key. The WindSonic4 will respond with the current SDI-12 address.

- To change the SDI-12 address, press the <enter> key, at the "CR200(X)>" prompt enter the command "SDI12>*a*A*b*!"; where *a* is the current address from the above step and *b* is the new address. The WindSonic4 will change its address and the datalogger will exit the SDI-12 Transparent Mode and respond with "Fail".

- Verify the new SDI-12 address. Press the <enter> key, at the "CR200(X)>" prompt enter the command "SDI12>?!" and press the <enter> key. The WindSonic4 will respond with the new address.

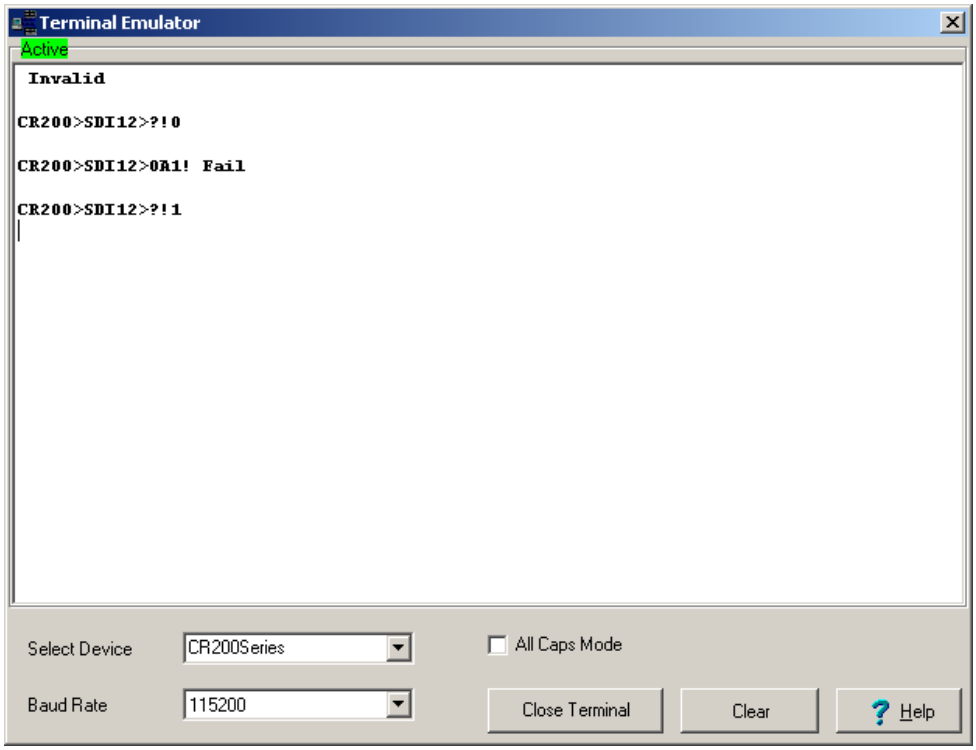


FIGURE 4. Screen Capture of the SDI-12 Transparent Mode on a CRBasic CR200(X)-series Datalogger using Control Port C1/SDI12 and Changing the SDI-12 Address from 0 to 1

9. Maintenance

There are no user-serviceable parts on the WindSonic. Keep the transducer paths clear of any obstructions. When clearing the transducer paths, do not remove or damage the transducer matching layer. The transducers can be gently cleaned with a cloth and mild detergent. Do no use solvents and avoid scratching or damaging the matching layers. The transducer's matching layers are the "rubber" caps on each of the transducers. Shoud the WindSonic be damaged, fail to output data, or send a nonzero diagnostic, contact Campbell Scientific for an RMA number before returning it for repair. For more information, see Section 12: Maintenance and Fault-Finding in the manual published by Gill Instruments.

10. Diagnostic Codes

The WindSonic outputs a diagnostic (Table 14) along with each wind direction and speed measurement. The example datalogger programs in this manual filter all data when the diagnostic is not 0. Short generated programs do not filter data based on the WindSonic diagnostic. Both the example programs in this manual and those generated in Short Cut record the number of times an error flag was set. If the WindSonic is not powered, not connected, is using the wrong COM port/SDI-12 address, or has missed a sample, the example programs in this manual will load NaN or -99999 for wind direction and speed, and the diagnostic (Table 15). The programs also report the number of good samples that were used in computing the on-line statistics. If the total number of good samples is less than 98% of the expected samples, the WindSonic may be in need of repair.

TABLE 13. Gill WindSonic Diagnostic Codes

Diagnostic	Status	Comment
0	Okay	All okay
1	Axis 1 Failed	Insufficient samples, possible path obstruction
2	Axis 2 Failed	Insufficient samples, possible path obstruction
4	Both Axis Failed	Insufficient samples, possible path obstruction
8	NVM error	Nonvolatile Memory checksum failed
9	ROM error	Read Only Memory checksum failed
10	Maximum Gain	Questionable wind measurements

TABLE 14. Example Datalogger Program Diagnostic Codes

Diagnostic	Datalogger Type	Comment
NaN	CRBasic	WindSonic not powered, not connected, wrong COM port/SDI-12 address, or missed sample
-99999	Edlog	WindSonic not powered, not connected, wrong SDI-12 address, or missed sample

11. Siting References

The following references give detailed information on siting wind direction and wind speed sensors.

EPA, 1987: *On-Site Meteorological Program Guidance for Regulatory Modeling Applications,* EPA-450/4-87-013, Office of Air Quality Planning and Standards, Research Triangle Park, NC, 27711.

EPA, 1989: *Quality Assurance Handbook for Air Pollution Measurements System*, Office of Research and Development, Research Triangle Park, NC, 27711.

The State Climatologist, 1985: *Publication of the American Association of State Climatologists: Height and Exposure Standards, for Sensors on Automated Weather Stations*, vol. 9, No. 4.

WMO, 1983: *Guide to Meteorological Instruments and Methods of Observation,* World Meteorological Organization, No. 8, 5th edition, Geneva, Switzerland.

Appendix A. WindSonic Orientation

A.1 Determining True North and Sensor Orientation

The orientation of the WindSonic "North Arrow Markers" is found by reading a magnetic compass and applying the site-specific correction for magnetic declination; where the magnetic declination is the number of degrees between True North and Magnetic North. Magnetic declination for a specific site can be obtained from a USGS map, local airport, or through a NOAA web calculator (Section A.2). A general map showing magnetic declination for the Conterminous United States in 2004 is shown in Figure A-1.

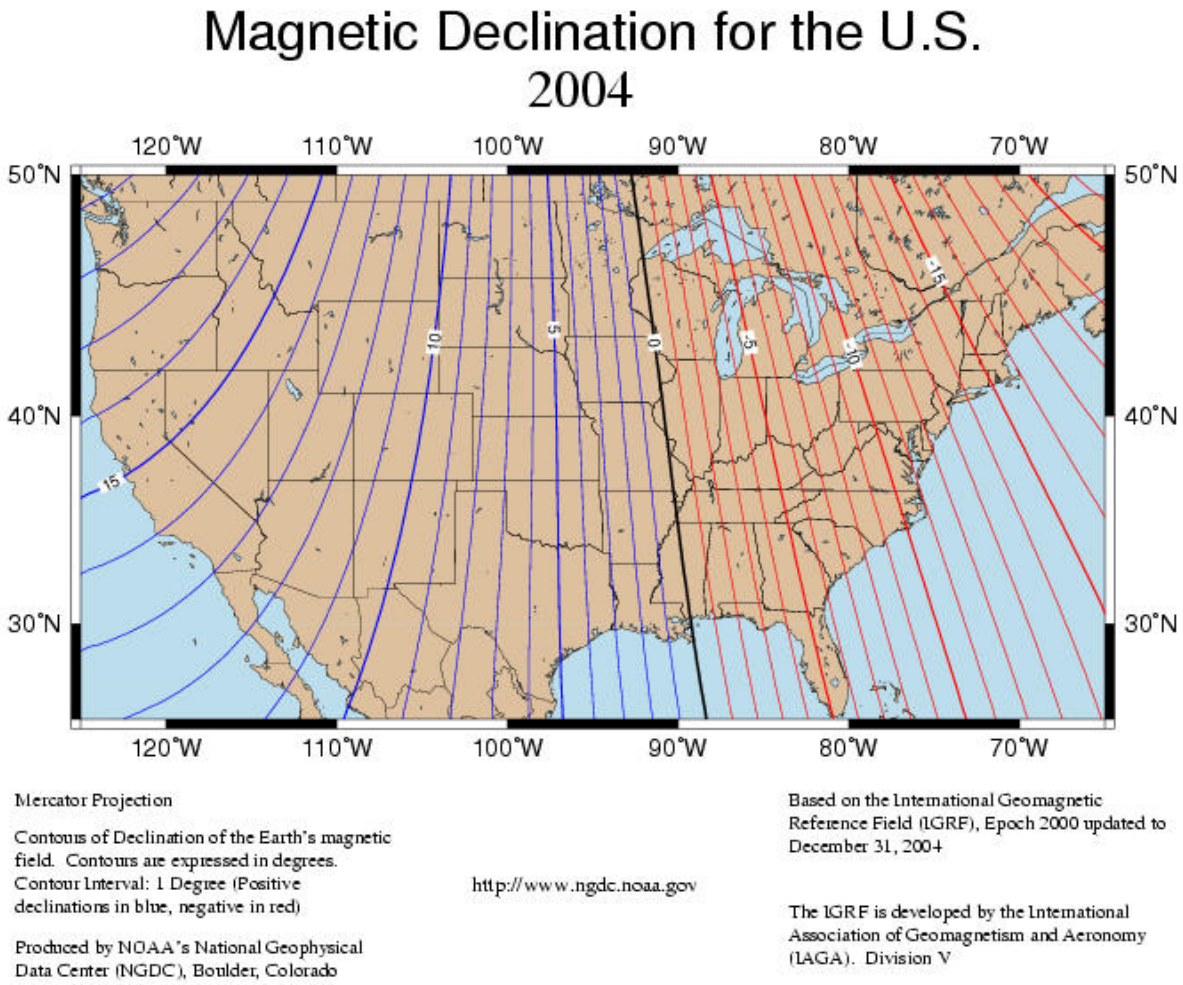


FIGURE A-1. Magnetic Declination for the Conterminous United States (2004)

Declination angles are always subtracted from the compass reading to find True North. A declination angle East of True North is reported as a positive value and is subtracted from 360 (0) degrees to find True North as shown Figure A-2. A declination angle West of True North is reported as a negative value and is also subtracted from 0 (360) degrees to find True North as shown in Figure A-3. Note that when a negative number is subtracted from a positive number, the resulting arithmetic operation is addition.

For example, the declination for Longmont, CO (10 June 2006) is 9.67°, thus True North is 360° - 9.67°, or 350.33° as read on a compass. Likewise, the declination for McHenry, IL (10 June 2006) is -2.68°, and True North is 0° - (-2.68°), or 2.68° as read on a compass.

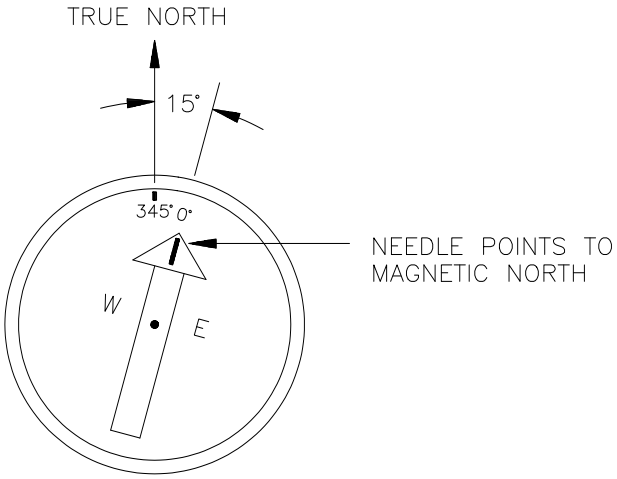


FIGURE A-2. A Declination Angle East of True North (Positive) is Subtracted from 360 (0) degrees to Find True North

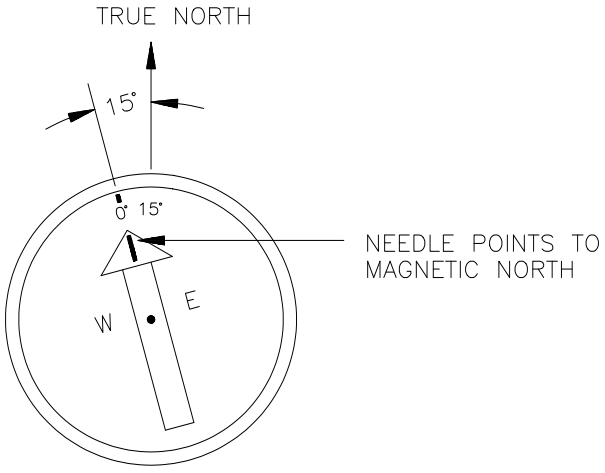
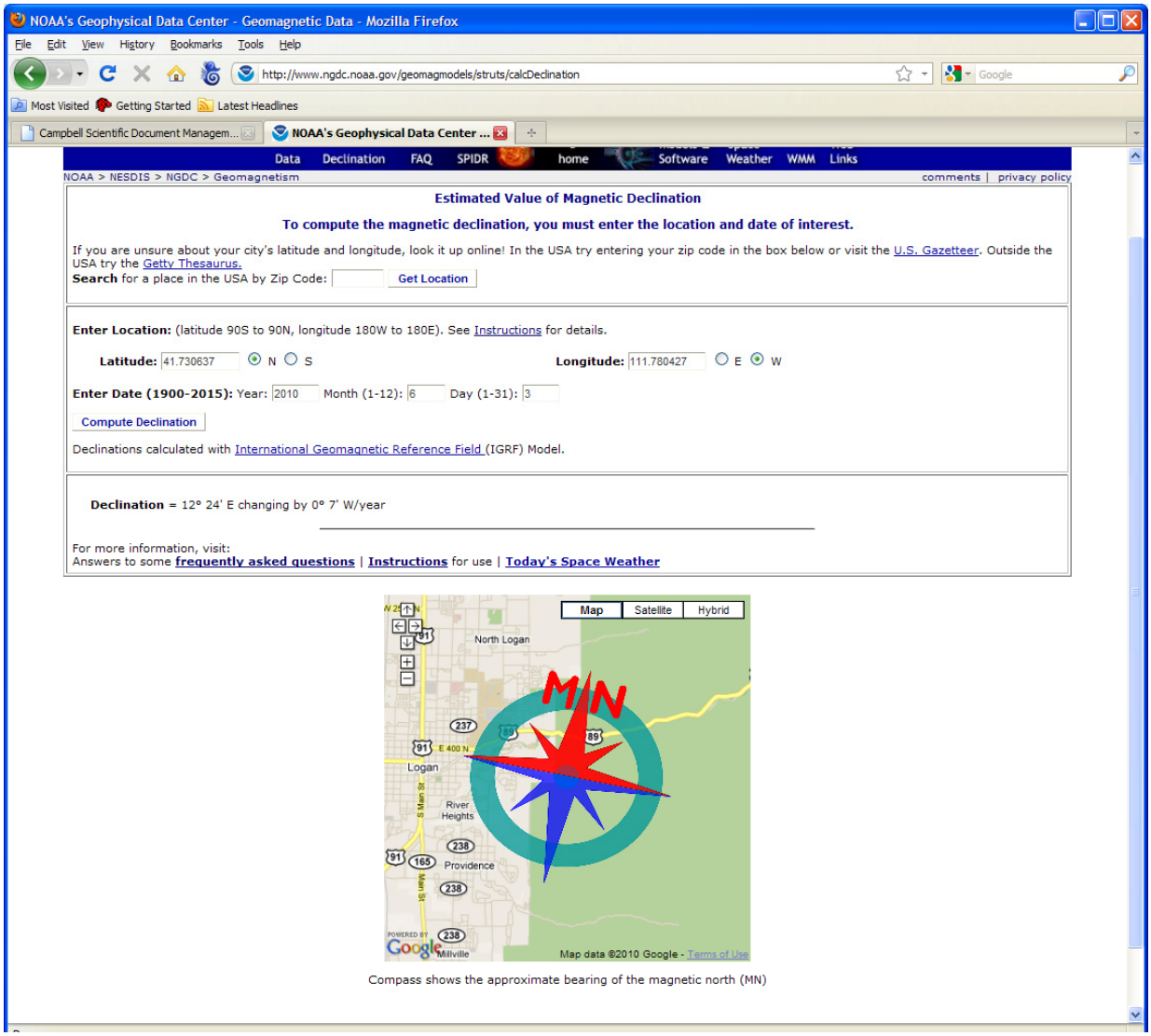


FIGURE A-3. A Declination Angle West of True North (Negative) is Subtracted from 0 (360) degrees to Find True North

A.2 Online Magnetic Declination Calculator

The magnetic declination calculator web calculator published by NOAA's Geophysical Data Center is available at the following url www.ngdc.noaa.gov/geomagmodels/Declination.jsp. After the web page loads, enter the site zip code, or longitude and latitude, then click on the "Compute Declination" button (Figure A-4).



Compass shows the approximate bearing of the magnetic north (MN)

FIGURE A-4. NOAA Web Calculator

The declination for Logan, UT is 12.4 degrees (3 June 2010). As shown in Figure A-4, the declination for Utah is positive (east of north), so true north for this site is 360 – 12.4, or 347.6 degrees. The annual change is -7 minutes/year or 7 minutes west per year.

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