revision G hardware

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APRS World, LLC

Wind Data Logger

User's Manual

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WARRANTY

APRS World's support policy is simple—***we want you to be happy!*** If you have a problem, please feel free to contact us. We will do our best to get you up and running as soon as possible.

The Wind Data Logger has a one-year limited warranty. We will repair or replace your Wind Data Logger if you encounter any manufacturing related problems within one year of purchase. We reserve the right to charge a reasonable fee for repairing units with user-inflicted damage or lightning damage. Please note that drilling holes in the case will leave your Wind Data Logger vulnerable to the elements, pests, and other natural damage. Therefore, **user created holes in the case will void your warranty**.

Any defective equipment must be returned for evaluation. It is your responsibility to ship the defective unit back to APRS World, LLC. We will pay for shipping the replacement to you. If it is necessary for you to receive a replacement for the defective unit prior to shipping it back for evaluation, then an invoice for the replacement equipment will be issued. If the defective unit is not returned or if we determine that the damage is not a warranty claim, then the invoice will become payable.

We reserve the right to upgrade your equipment to an equivalent or better model. This warranty does not cover the accuracy of the sensors connected to the Wind Data Logger or the accuracy of the data collected by the Wind Data Logger.

TECHNICAL SUPPORT

The Wind Data Logger is designed to be easy to install and operate. After the initial installation of your Wind Data Logger equipment, technical support is limited to issues not covered in our Wind Data Logger manual. APRS World, LLC reserves the right to charge a fee for technical support that either extends beyond the one year warranty period or for questions that are addressed in the latest manual.

ON-LINE SUPPORT

See our website for further and specialized technical information:

http://www.aprsworld.com/wind2/

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INTRODUCTION

Thank-you for purchasing APRS World's Wind Data Logger! We are confident that you will find this to be a valuable tool and sound investment in assisting you with wind site evaluation and other meteorological and monitoring applications.

The Wind Data Logger is designed to provide an affordable and easy-to-use solution for wind site evaluation and wind generator performance. It easily supports both simple and complex monitoring applications. The Wind Data Logger records wind speed, gust, and direction, as well as the time and date, temperature, battery voltage, and other important wind parameters. The data logger is capable of recording wind speed from up to three anemometers, making it ideal for complex studies involving multiple wind speed instruments and other sensors. In addition to the standard sensors, it can collect data from most analog or pulse output sensors.

The Wind Data Logger records directly to a Secure Digital (SD™) card to provide convenient data downloads and will store years of data. This means fewer trips to retrieve data from the Wind Data Logger. For your convenience, a new file is created and saved to the card for each day the data logger is in use. Using the recorded data is simple. The SD™ card is inserted into a card reader attached to the USB port on your computer (Windows, Macintosh, and Linux) and will then show up as a drive.

To view and graph the data, click on the spreadsheet corresponding to the day of interest. Microsoft Excel, OpenOffice.org, or practically any spreadsheet program can be used to view, graph, and analyze your wind data. We also provide web-based software that makes your analysis even easier. Simply upload your data and our software will automatically plot the data as well as provide basic statistics.

NAVIGATION

The Wind Data Logger's easy-to-use interface includes a 16 character by 2 line backlit LCD screen, which displays current information and is used for configuring the data logger. A simple menu-driven interface using the LCD and three front panel buttons makes setup easy. A bright backlight makes the data logger easy-to-use at night. A Secure Digital (SD™) card slot makes recording and accessing data easy. **(See Figure 1.)**

BUTTONS

▼: Scrolls through display screens and allows user calibration in setup menus. Moves values in the negative direction.

SELECT: Press to enter ***Setup*** menu and to set user calibrated displays

▲: Scrolls through display screens and allows user calibration in setup menus. Moves values in the positive direction.

All buttons respond to a single press; holding a button will not cause multiple actions to occur.

SECURE DIGITAL™ CARD SLOT

The Wind Data Logger has a spring-loaded memory card slot. To insert a Secure Digital™ (SD™) card, place the card face up into the slot on the front panel and press the card inwards until the card clicks into place. To remove card, press the card slightly inward and the card will release.

The card should not be removed by pulling it out without first pressing it inwards. If a card is pulled out in this manner, both the memory card and the card socket may be damaged.

Figure 1. ***Wind Data Logger Interface.***

WIND DATA LOGGER QUICK-START GUIDE

This section of the manual will provide you with all of the basic information you need to know to get your Wind Data Logger up and running. We suggest reading it in its entirety. More advanced user applications are found in the next section and may not be applicable to all users.

POWERING THE WIND DATA LOGGER

The Wind Data Logger requires a DC power source capable of supplying 7 to 32 VDC with a current of at least 50 mA. The Wind Data Logger should be protected with an over-current device that will allow no more than 300 mA before tripping. A small fuse is suitable. An AC wall adapter with a rating of 300 mA or less is also suitable, although the wall adapter may be damaged in the event of a Wind Data Logger failure. The polarity is usually denoted on the power source with a symbol as shown in **Figure 2**. The power input connector (**Figure 3**) is located on the back of the Wind Data Logger in the upper left; it is a 2.1 by 5.5 mm connector with positive center conductor. The positive voltage must be applied to the center pin and ground on the outside conductor. Reversing positive and negative **will destroy** the data logger and void your warranty. If this is not clear, please call us.

Figure 2. *Symbol typically found on power adapter.*

Note: If you have a power pigtail connector from APRS World, the white-striped wire is positive. This only applies to APRS World power pigtails and cannot be assured for connectors obtained from other sources.

CLOCK BATTERY BACKUP

The data logger's real-time clock uses a 3-volt lithium coin cell battery (**Figure 3**) to maintain the clock while power is disconnected. CR1225, BR1225, or any 3-volt 12.5 by 2.5 mm battery may be used. These are common watch batteries and should be available from most stores.

The clock battery has an estimated 10 to 15 year life span in the Wind Data Logger. If your data logger "freezes" or does not retain its date and time without power, then the battery likely needs to be replaced. To replace the battery, use a small screwdriver or toothpick to pop the old battery out of the battery holder. Insert a new battery with the writing side up.

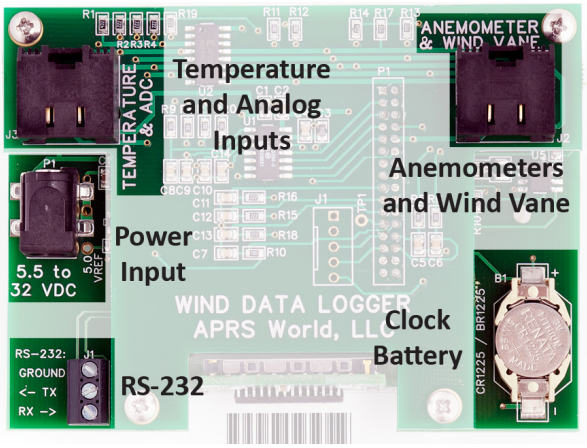


Figure 3. ***Wind Data Logger circuit board.***

SENSOR AND CABLE HOOKUP

Connect the anemometer and temperature sensor to the corresponding Wind Data Logger inputs (**Figure 3**) using CAT 5 or better computer cables and RJ-45 connectors. This is the type of cable and connector generally used for wiring an Ethernet network. A cable length of up to 150 m (500 ft) between the instruments and the Wind Data Logger should not be a problem; however, a long cable is more susceptible to lightning.

If you would like to hook non-standard sensors up to the Wind Data Logger, please refer to the pin-out information in the **Advanced Applications** section of this manual.

RS-232 INTERFACE

See Wind Data Logger Advanced Applications section.

MOUNTING THE DATA LOGGER

The Wind Data Logger can be mounted indoors or outdoors in a weatherproof enclosure, and must be protected from water, dust, and mechanical damage. APRS World, LLC offers a full line of standard and custom outdoor enclosures to simplify your installation.

The Wind Data Logger is designed to mount in a North American style, double-gang electrical box. The four screw holes in the bezel and the provided screws match this type of box. Home improvement and hardware stores typically carry a variety of double-gang electrical boxes. Select a box at least 3.30 cm (1.5 in) deep to fit the Wind Data Logger and cables.

If an off-the-shelf enclosure is not suitable for your application, there is a full-size template of the Wind Data Logger cutout in the appendix and on our website:

http://www.aprsworld.com/wind2/documents/

This dimensioned drawing can be copied or printed and used as a cutting template or machinist drawing.

MOUNTING THE TEMPERATURE SENSOR

To obtain an accurate temperature reading, the temperature sensor (APRS6550) should be mounted in a shaded area that allows air to move over the sensor. Ideally, the sensor should be located within a solar radiation shield. The sensor should be located 1.5 m ± 0.30 m (5 ft ± 1 ft) from the surface of the ground, or 0.60 m (2 ft) above the average maximum snow depth, depending on which method corresponds to the higher level. Thus, if average snow depth is 1.2 m (4 ft) for the area of interest, we recommend mounting the temperature sensor at a height of 1.8 m (6 ft).

USER INTERFACE

Use the LCD screen and three colored buttons on the front panel to navigate the user interface as described in the ***Navigation*** section of the Introduction (**Figure 1**). There is no need to connect the Wind Data Logger to a computer for normal configuration or use. When power is applied to the Wind Data Logger, the screen should begin to display (**Figure 4**).

If the screen is blank, check the power supply before contacting customer support. The data logger's default settings will work with the components in the Starter Package (APRS6050); however, if there is ever a need to replace the clock battery, the date and time must be reset using steps discussed later in the manual.

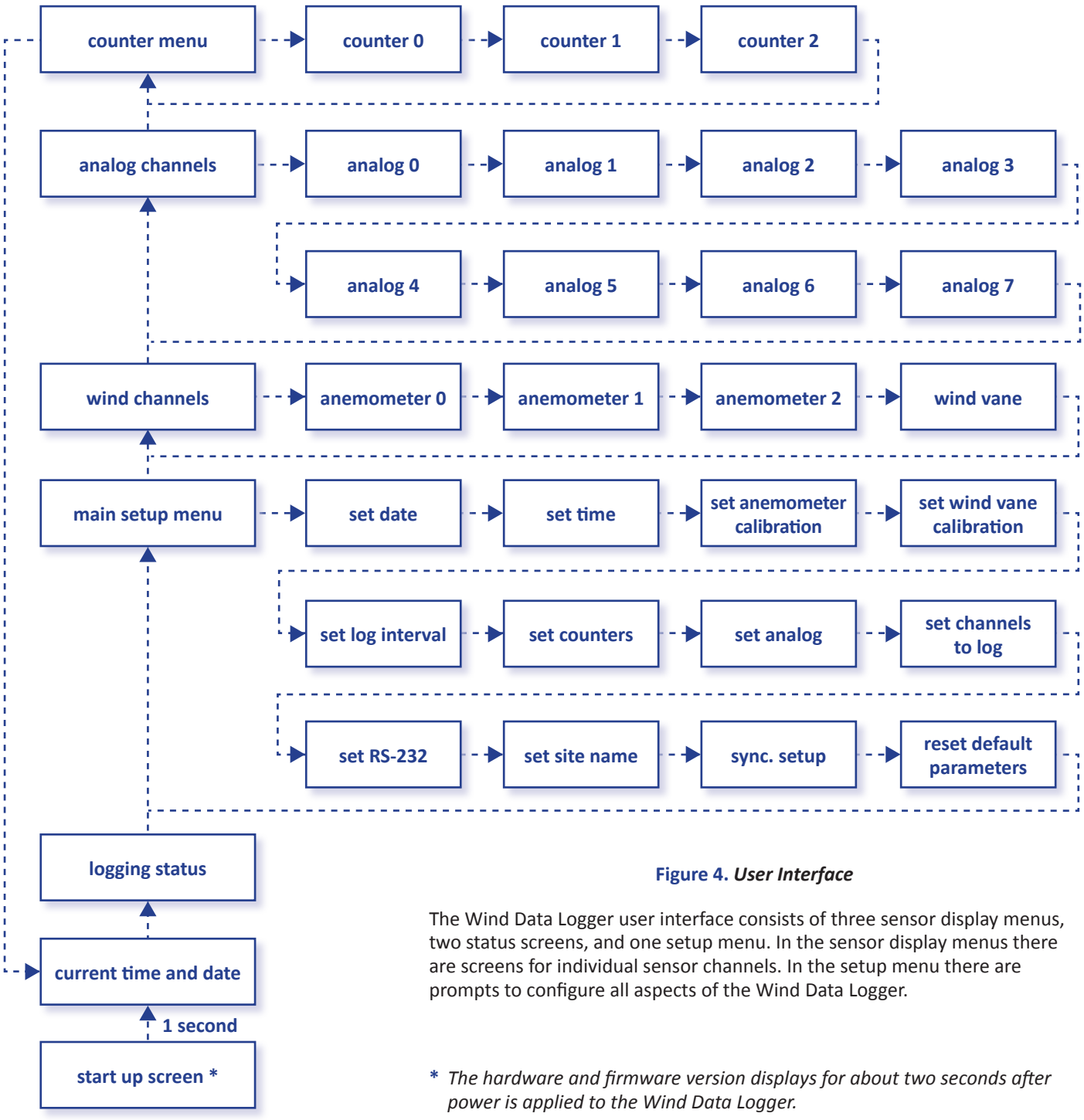


Figure 4. ***User Interface***

The Wind Data Logger user interface consists of three sensor display menus, two status screens, and one setup menu. In the sensor display menus there are screens for individual sensor channels. In the setup menu there are prompts to configure all aspects of the Wind Data Logger.

* *The hardware and firmware version displays for about two seconds after power is applied to the Wind Data Logger.*

MAIN DISPLAY SCREENS

Unless you have changed the anemometer calibration values, the Wind Data Logger will default to MPH for the APRS World #40R Anemometer (APRS6504). See Anemometer Calibration in the **CONFIGURATION AND OPERATION Table** for details on changing anemometer calibration.

SETTING THE TIME AND DATE

Using the ***Time*** and ***Date*** screens, one can both view and set the current date and time. The Wind Data Logger incorporates a real-time clock that keeps accurate time while power is disconnected. The clock does not automatically adjust for daylight savings; however it does automatically adjust for leap years. The date format used throughout the Wind Data Logger is YYYY-MM-DD.

We recommend that you set the date and time to GMT (Greenwich Mean Time) / UTC (Coordinated Universal Time) time to avoid having to change the clock for daylight savings. GMT and UTC time are based on the date and time at the Prime Meridian and do not change with daylight savings adjustments. Local time is found by adding or subtracting an offset from GMT. For example, Chicago is 6 hours earlier than GMT in winter time, and 5 hours earlier than GMT in the summer / daylight savings time.

See the **CONFIGURATION AND OPERATION Table** for sample screen shots and detailed instructions for changing time and date. The same method is used with all Wind Data Logger setup screens.

ORIENTING THE WIND VANE

To orient the wind vane, in the ***Main Setup Screen*** scroll to the ***Wind Vane Setup*** screen and press **SELECT** to set. First, using the **SELECT** button, choose the wind vane type, (see **CONFIGURATION AND OPERATION Table**). There are two ways to orient the wind vane to north:

1. Connect it to the data logger on the ground and rotate the vane until the display reads 000°. Tape the wind vane in place so it cannot rotate. Install the wind vane and orient it to true north using a compass and the appropriate magnetic declination information. Remove the tape once the wind vane is oriented to north.
2. Install the wind vane pointing any random direction and then use the Wind Vane Calibration Screen on the data logger. So, if the wind vane reads 240° when it is pointing north, you can select an offset of 120° (240° + 120° = 360° or 0°) to have it read 0° or true north.

REFERENCING WIND DIRECTION

Typically, wind direction is referenced to true north. In most locations, magnetic north (where a compass points) and true north (direction to the North Pole) are not the same. The difference between the two is called the magnetic declination. Magnetic declination varies from location to location and as time passes. To accurately direct the wind vane using a magnetic compass, you will need to know the magnetic declination for your location. Links to this information can be found on the Internet at:

http://www.aprsworld.com/info/declination/

DATA LOGGING

The Wind Data Logger can record measurements directly to an industry standard Secure Digital™ or Multi-Media Card™. The data logger records both raw and processed values in a simple text format that can be opened with any spreadsheet or text editor.

STARTING AND STOPPING LOGGING

Logging commences after the memory card is inserted into the data logger and terminates after it is removed. Use the Logging Status screen to verify that the data logger is recording. If a memory card is inserted but the data logger shows “NOT READY” then there is a problem and the data logger WILL NOT record anything. Check to be sure the card is fully inserted and meets the memory card requirements outlined below.

MEMORY CARD REQUIREMENTS

This model of APRS World's Wind Data Logger is compatible with all sizes of MMC (Multi-Media Card™) or SD (Secure Digital™) cards up to 2GB. However, it will not work with Secure Digital High Capacity (SDHC) cards. We recommend formatting the SD Card with the FAT32 file system for this data logger model.

Due to differences in manufacturing specifications as well as quality issues with SD cards from various manufacturers, h

DATA

The Wind Data Logger records Comma Separated Vertical (CSV) files to the memory card. CSV data can be used by nearly any spreadsheet software, SQL databases, standard software, and custom software. The Wind Data Logger generates one file per calendar day. The file name is YYYYMMDD.CSV (ex. 20070713.CSV) where YYYY is the four-digit year, MM is the two-digit month, and DD is the two-digit day. Each file is stored in the main directory or folder of the SD or MMC. The data files consist of one record per line. The data logger also writes two other files that contain meta information about the channels being logged. For most applications these files can be ignored.

On most computers, a single file can be opened in a text editor by simply double clicking on its icon. To open a file in a spreadsheet program, first launch the program, then use the ***Open*** command in the File menu to select the CSV file created by the Wind Data Logger. In the ***Open*** window, you may need to select ***text***, ***comma-delimited text***, or ***CSV*** in order to select and open the file.

Microsoft Excel, Gnumeric, and Open Office.org Calc are all good spreadsheet programs. Gnumeric and OpenOffice.org Calc are free and can be downloaded from the Internet.

The Wind Data Logger provides raw data without column headings. To add those headings, go to

http://www.aprsworld.com/wind2/documents/

and download the "Spreadsheet Headings" XLS file. Simply paste your data below the headings. Or you may open your data file then copy and insert the headings into the top four rows.

If you are having problems with your Wind Data Logger and need to send data to APRS World, please send the raw data files only, not files that have been processed using your spreadsheet software.

The samples below show how the data will look in raw form and when opened in Microsoft Excel. The data is from a Wind Data Logger with one anemometer, a wind vane, and a temperature sensor.

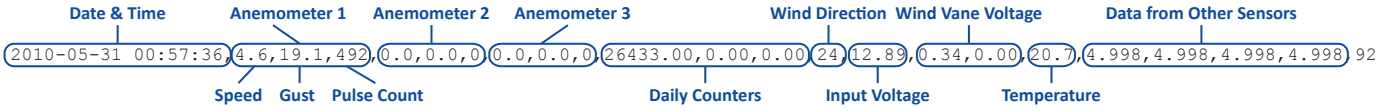


Figure 5. ***Raw Data from a Wind Data Logger***

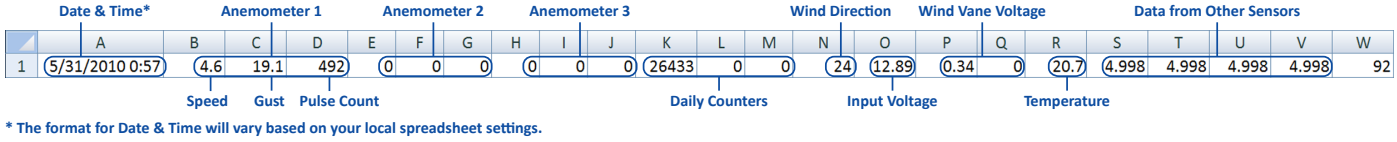


Figure 6. ***Data opened in Microsoft Excel***

RECORD FORMAT

During each logging interval, the Wind Data Logger records the readings from all of its sensors to create a new record in the CSV file. Each field of the record is separated by a comma. A new line marks the end of each record. When a file is correctly loaded into a spreadsheet, each field will be in its own column and each record will be on one line (**Table 1**).

SPREADSHEET FIELD DESCRIPTIONS

Note: Most channels on the Wind Data Logger can be disabled. If a channel is disabled, there will be no numbers showing in that spreadsheet column.

Table 1. ***Spreadsheet.***

The following channels show wind speed, wind gust, direction, and pulses in day. Anemometer / pulse inputs are set on the "Anemometer Setup" menu. Counter inputs are configured in the "Counter Setup" menu. Wind Direction is configured in the "Wind Vane" setup menu.				
Field	**Name**		**Description**	**Format / Range**
A	Date and Time		Date and time	YYYY-MM-DD HH:MM:SS •YYYY is year (2000 to 2099) •MM is month (01 to 12) •DD is day (01 to 31) •HH is hour (00 to 23) •MM is minute (00 to 59) •SS is second (00 to 59)
B	Anemometer 0 Pulse Input 0	Speed *	Wind speed based on anemo_m and anemo_b calibration values	Floating point, 32 bit
C		Gust *	Maximum wind speed during interval based on anemo_m and anemo_b calibration values	
D		Pulse Count	Rotations during interval	Unsigned integer, 16 bit
E	Anemometer 1 Pulse Input 1	Speed *	Same as Anemometer 0	
F		Gust *		
G		Pulse Count		
H	Anemometer 2 Pulse Input 2	Speed *	Same as Anemometer 0	
I		Gust *		
J		Pulse Count		
K	Counter 0		Counter value based on counter_m and counter_b values	Floating point, 32 bit
L	Counter 1			
M	Counter 2			
N	Wind Direction		In degrees	Integer, 0 to 359

* Please note that the wind speed and wind gust readings are not averaged. Instructions for determing those averages are in **CONVERTING ANEMOMETER PULSE COUNT TO AVERAGE WIND SPEED** on page 21.

The following channels show analog voltages from a variety of inputs. Each channel has a linear equation of the form y=m*voltage + b applied to the raw 0 to 5 volt measurement. These linear equations are set in the "ADC Setup" menu.				
Field	**Channel, Resolution**	**Typical Use**	**Source**	**Format / Range**
O	A0, 10 bits	Input Voltage	Supply voltage for data logger.	Floating point, 32 bit
P	A1, 10 bits	Wind Vane Potentiometer 0	Typically represents voltage from wind vane potentiometer. Voltage from “TEMP&ADC” jack pin 6.	
Q	A2, 10 bits	Wind Vane Potentiometer 1	Typically represents voltage second wiper of wind vane potentiometer. Voltage from “TEMP&ADC” jack pin 7.	
R	A3, 10 bits	Temperature Sensor	Typically represents voltage from included temperature sensor. Voltage “TEMP&ADC” pin 1.	
S	A4, 12 bits	User Analog Input	Voltage from “TEMP&ADC” pin 4.	
T	A5, 12 bits	User Analog Input	Voltage from “TEMP&ADC” pin 5.	
U	A6, 12 bits	User Analog Input	Voltage from “TEMP&ADC” pin 6.	
V	A7, 12 bits	User Analog Input	Voltage from “TEMP&ADC” pin 7.	
W	Cylic Redundancy Check (CRC)		Calculated checksum of columns A to W	Integer, 8 bit (see CRC discussion in manual)

The following channels are sent to the RS-232 port but are not logged to the SD card. Site name is set in “Site Name” menu.			
Field	**Name**	**Description**	**Format / Range**
X	Site Name		String of up to 9 ASCII characters
Y	SD Card Logging Status		0 if "NOT READY", 1 if "LOGGING"
Z	Not used		Always 0
AA	Cylic Redundancy Check (CRC)	Calculated checksum of columns X to AA	Integer, 8 bit (see CRC discussion in manual)

CYCLIC REDUNDANCY CHECK

The CRC of the data is calculated one byte at a time using the following algorithm:

```
int8 calc_crc(int8 old_crc,int8 newbyte) {
  int8 ctr;
  int1 fbbit;
  for (ctr=0;ctr<8;ctr++) {
      fbbit=((newbyte & 0x80)==0x80)^old_crc;
      newbyte<<=1;
      old_crc>>=1;
      if (fbbit==1)
          old_crc^=0x83;
  }
  return(old_crc);
}
```

The algorithm is run on the first character of the data through the comma immediately proceeding the CRC value.

The table below and on the following pages provides screen shots for the Wind Data Logger display. Beginning with the status screens, this table will walk you through the configuration process and also shows sample data screens. The primary menus are: **Main Setup Menu**, **Wind Channels**, **Analog Channels**, and **Counter Channels**. Sub-menus of the **Main Setup Menu** are: **Date Setup**, **Time Setup**, **Anemometer Setup**, **Wind Vane Setup**, **Log Interval**, **Counter Setup**, **Analog Setup**, **Channels to Log**, **RS-232 Setup**, **Wind Vane Setup**, **Site Name Setup**, **Sync. Setup**, and **Restore Defaults**. The Wind Data Logger has three keys: ▼ which moves backwards or down (depending on the screen); **SELECT** which selects, sets, or moves to the next character; and ▲ which moves forwards or up (depending on the screen).

	Display Screen	Description
Status Screens	Date: 2008-08-13 Time: 13:00:00	Current date and time. Date is setup using the Date Screen in the Main Setup Menu. Time is setup using the Time Screen in the Main Setup Menu. Time is in 24-hour format.
	Status: NOT RDY 00000/00060 sec	The Status Screen can be viewed by pressing the ▼ key.
	Status: LOGGING 00000/00060 sec	Displays LOGGING when a Secure Digital ™ card is inserted. Displays NOT RDY when no memory card is inserted or there is an error accessing the card. The first number shows the number of time (seconds) since the last write to the memory card. The second number shows the logging interval.
Main Setup	Main Setup Menu <- SELECT ->	Press the **SELECT** button to enter the Main Setup Menu. Use the screens in the Main Setup Menu to configure and calibrate the Wind Data Logger. Use the ▼ and ▲ buttons to change user calibrated values and **SELECT** to set values.
	Logging Disabled while in setup!	Briefly displays to remind user that system is offline during setup.
Date Setup	Date: 2009-07-21 < Set >	The Date Setup Screen will display. Press the **SELECT** button to set the date.
	Date: 2009-07-21 Set +	The last digit of the year is underlined. Press ▼ to decrease the year or ▲ to increase the year. When year is correct, press **SELECT** to set the year and move to the month. Set the month and day using the same method. Press **SELECT** to return to the Date Setup Screen.
Time Setup	Time: 15:31:30 < Set >	Press ▲ to advance to the Time Setup Screen. Press **SELECT** to set the time.
	Time: 15:31:30 Set +	Note that the last digit of the hour is underlined. Press the ▼ to decrease the hour or ▲ to increase the hour. When the hour is correct, press the **SELECT** button to set the hour and move to the minutes. Set the minutes and seconds using the same method. Press **SELECT** to return to the Time Setup Screen.
	Main Setup Menu <- SELECT ->	Press ▼ twice to return to the Main Display Loop or ▲ to advance to the Anemometer Setup menu.

	Display Screen	Description
Anemometer Setup	Anemometer Setup < SELECT >	Press the **SELECT** key to setup the Anemometers.
	Anemometer 0 < SELECT >	Press the **SELECT** key to setup the Anemometer 0. After Anemometer 0 setup is complete, follow the same instructions from Anemometers 1 and 2 (if applicable).
	+0000.8570 AN_MO Set +	Correct setting for use with the #40R Anemometer. In MPH, the setting for the 6500 Anemometer is **+0001.7580** and the setting for the NRG #40H is **+0001.7110**. Other input devices such as the APRS Wattnode may be used with the Wind Data Logger. Settings for these devices are provided separately.
	+0000.7250 AN_BO Set +	Correct setting for use with #40R Anemometer. In MPH, the setting for the 6500 Anemometer is **+0002.1210** and the setting for the NRG #40H is **+0000.7800**. Other input devices such as the APRS Wattnode may be used with the Wind Data Logger. Settings for these devices are provided separately.
	ANEMOMETER > 0 Next +	Press the ▼ key to decrease the value. Press the ▲ key to increase the value. Press the **SELECT** key to advance to the next character. When the last character is edited, press the **SELECT** key to move to the next screen.
	MPH> AN0_UNIT Next +	Press the ▼ key to decrease the value. Press the ▲ key to increase the value. Press the **SELECT** key to advance to the next character. When the last character is edited, press the **SELECT** key to move to the next menu.
	Anemometer Setup < SELECT >	After all three anemometers are setup properly, press the ▲ key to advance to the Wind Vane Setup menu.
Wind Vane Setup	Wind Vane Setup < Set >	Press the **SELECT** key to setup the Wind Vane.
	Wind Vane Type: LINEAR* FASC	The default setting is for the Linear / NRG #200P wind vane (APRS6507). The Fascinating mode is available for older models. Press the ▲ key to keep the default setting, or press the ▼ key to change it to Fascinating mode if needed. Also note that the select key does nothing in this screen.
	Dir Offset: 000- Set +	Press the ▼ key to decrease the value. Press the ▲ key to increase the value. Press the **SELECT** key to advance to the next character. When the last character is edited, press the **SELECT** key to move to the next menu.
	Wind Vane Setup < Set >	After the Wind Vane has been setup properly, press the ▲ key to advance to the Log Interval Setup menu.
Log Interval Set	Log Interval < SET >	Press the **SELECT** key to setup the Log Interval.
	Log Sec: 00060 SET +	Set the logging interval between 10 and 16,000 seconds.
	Log Interval < SET >	After the Log Interval has been setup properly, press the ▲ key to advance to the Counter Setup menu.

	Display Screen	Description
Counter Setup	Counter Setup < SELECT >	Press the **SELECT** key to setup the Counter.
	Counter 0 < SELECT >	Press the **SELECT** key to setup the Counter 0 or press the ▼ or ▲ key to choose a different counter to setup.
	+0001.0000 CNT_M SET +	Press the ▼ key to decrease the value. Press the ▲ key to increase the value. Press the **SELECT** key to advance to the next character. When the last character is edited, press the **SELECT** key to move to the next screen.
	+0000.0000 CNT_B SET +	Press the ▼ key to decrease the value. Press the ▲ key to increase the value. Press the **SELECT** key to advance to the next character. When the last character is edited, press the **SELECT** key to move to the next screen.
	ANEMO 0 ->CNT0 NEXT +	Press the ▼ key to decrease the value. Press the ▲ key to increase the value. Press the **SELECT** key to advance to the next character. When the last character is edited, press the **SELECT** key to move to the next screen.
	CNT-> CNT0_UNIT NEXT +	Press the ▼ key to decrease the value. Press the ▲ key to increase the value. Press the **SELECT** key to advance to the next character. When the last character is edited, press the **SELECT** key to move to the next screen.
	Counter Setup < SELECT >	After the Counters have been setup properly, press the ▲ key to advance to the Analog Setup menu.
Analog Setup	Analog Setup < SELECT >	Press the **SELECT** key for Analog setup. **(Repeat for Analog 0-7)**
	Analog 0 < SELECT >	Press the **SELECT** key for Analog 0 setup or press the ▼ or ▲ key to choose a different analog channel to setup.
	+0008.0000 A_MO Set +	Press the ▼ key to decrease the value. Press the ▲ key to increase the value. Press the **SELECT** key to advance to the next character. When the last character is edited, press the **SELECT** key to move to the next screen.
	+0000.0000 A_BO Set +	Press the ▼ key to decrease the value. Press the ▲ key to increase the value. Press the **SELECT** key to advance to the next character. When the last character is edited, press the **SELECT** key to move to the next screen.
	INPUT VOLTAGE->A0 Next +	Press the ▼ key to decrease the value. Press the ▲ key to increase the value. Press the **SELECT** key to advance to the next character. When the last character is edited, press the **SELECT** key to move to the next screen.
	UDC -> A0_UNITS Next +	Press the ▼ key to decrease the value. Press the ▲ key to increase the value. Press the **SELECT** key to advance to the next character. When the last character is edited, press the **SELECT** key to move to the next menu.
	Analog Setup < SELECT >	After the Analog Setup is complete, press the ▲ key to advance to the Channels to Log Setup menu.

	Display Screen	Description
Channels to Log Setup	Channels to Log < Set >	Press the **SELECT** key for Channels to Log setup.
	00: Anemometer 0 ENABLE* DISABLE	Press the ▼ key to enable Anemometer 0 or press the ▲ key to disable Anemometer 0. Continue this process for Anemometers 1 and 2. **IMPORTANT:** For all screens with ENABLE and DISABLE commands, the asterisk will not move until you scroll through the Setup the next time.
	03: Counter 0 ENABLE* DISABLE	Press the ▼ key to enable Counter 0 or press the ▲ key to disable Counter 0. Continue thisprocess for Counters 1 and 2.
	06: Wind Directi ENABLE* DISABLE	Press the ▼ key to enable Wind Direction or press the ▲ key to disable Wind Direction.
	07: Analog 0 ENABLE* DISABLE	Press the ▼ key to enable Analog 0 or press the ▲ key to disable Analog 0. Continue this process for Analog 1 through 7.
	Channels to Log < Set >	After the Channels to Log Setup is complete, press the ▲ key to advance to the RS-232 Setup menu.
RS-232 Setup	RS-232 Setup < Set >	Press the **SELECT** key for RS-232 setup.
	RS-232 Disabled* Set +	Default RS-232 setup is Disabled. To enable RS-232, press the ▼ key and select the baud rate using the next screen.
	Baud: 57600* Set +	Press the ▲ key to increase the baud rate or press the ▼ key to decrease the baud rate. When finished, press the **SELECT** key to return to the setup menu.
	RS-232 Setup < Set >	After the Channels to Log Setup is complete, press the ▲ key to advance to the Site Name Setup menu.
Site Name Setup	Site Name Setup < SELECT >	Press the **SELECT** key to setup the Site Name.
	A0000 → SITE Next +	Scroll up or down to rename site, if desired.
	Site Name Setup < SELECT >	After the Site Name Setup is complete, press the ▲ key to advance to the Sync. Setup menu.

	Display Screen	Description
Sync. Setup	Sync. Setup < SET >	Press the **SELECT** key for Sync setup.
	* Set +	Press the ▲ key choose from the following options: `No RS-232 sync`, `Send on Log`, or `Log on receive`.
	Sync. Setup < SET >	After the Site Name Setup is complete, press the ▲ key to advance to the Restore Defaults menu.
Restore Defaults	Restore Defaults < SET >	Press the **SELECT** key to reset the device to the Default values. This is useful if you are having problems with the unit or would simply like to restore it to the factory settings. **NOTE:** This will reset all of your previous settings!
	Restore Defaults NO YES	Select "NO" or "YES" to restore system to factory default settings. **NOTE:** If you choose "YES", you will need to re-enter all of your necessary setup values.
	Restore Defaults < SET >	Press the ▲ key to complete setup of the Wind Data Logger.
Main Setup	Logging re-enabled!	After all Setup menus have been visited, the unit will return to active logging.
	Main Setup Menu <- SELECT ->	The Main Setup Menu will return after logging is re-enabled. Press the ▼ key to return to the Date and Time Screen or press the ▲ key to move forward to the Wind Channels screen.
Wind Channels	Wind Channels < SELECT >	Choose **SELECT** to obtain readings.
	AN0:ANEMOMETER 0.0 MPH/0.0 max	*Sample data screen.* Press the ▲ key to move forward to the next screen or press the ▼ key to return to the previous screen.
	AN1:ANEMOMETER 0.0 MPH/0.0 max	*Sample data screen.* Press the ▲ key to move forward to the next screen or press the ▼ key to return to the previous screen.
	AN2:ANEMOMETER 0.0 MPH/0.0 max	*Sample data screen.* Press the ▲ key to move forward to the next screen or press the ▼ key to return to the previous screen.
	Wind Direction: 000- (N)	*Sample data screen.* Press the ▲ key to move forward to the next screen or press the ▼ key to return to the previous screen.
	Wind Channels < SELECT >	After viewing the Wind Channels settings, press the ▲ key to advance to the Analog Channels menu.

	Display Screen	Description
Analog Channels	Analog Channels < SELECT >	Choose **SELECT** to view settings for the Analog Channels.
	A0:INPUT VOLTAGE 9.14 VDC	*Sample data screen.* Press the ▲ key to move forward to the next screen or press the ▼ key to return to the previous screen.
	A1:WIND DIR. 0 0.00 VDC	*Sample data screen.* Press the ▲ key to move forward to the next screen or press the ▼ key to return to the previous screen.
	A2:WIND DIR. 1 0.00 VDC	*Sample data screen.* Press the ▲ key to move forward to the next screen or press the ▼ key to return to the previous screen.
	A3:TEMPERATURE 000.0 -C	*Sample data screen.* Press the ▲ key to move forward to the next screen or press the ▼ key to return to the previous screen.
	A4:EXT. ADC 0 4.998 VDC	*Sample data screen.* Press the ▲ key to move forward to the next screen or press the ▼ key to return to the previous screen.
	A5:EXT. ADC 1 4.998 VDC	*Sample data screen.* Press the ▲ key to move forward to the next screen or press the ▼ key to return to the previous screen.
	A6:EXT. ADC 2 4.998 VDC	*Sample data screen.* Press the ▲ key to move forward to the next screen or press the ▼ key to return to the previous screen.
	A7:EXT. ADC 3 4.998 VDC	*Sample data screen.* Press the ▲ key to move forward to the next screen or press the ▼ key to return to the previous screen.
	Analog Channels < SELECT >	After viewing the Analog Channels settings, press the ▲ key to advance to the Counter Channels menu.
Counter Channels	Counter Channels < SELECT >	Choose **SELECT** to view settings for the Counter Channels.
	0: ANEMO 0 0.00 CNT today	*Sample data screen.* Press the ▲ key to move forward to the next screen or press the ▼ key to return to the previous screen.
	1: ANEMO 1 0.00 CNT today	*Sample data screen.* Press the ▲ key to move forward to the next screen or press the ▼ key to return to the previous screen.
	2: RAIN 0.00 IN today	*Sample data screen.* Press the ▲ key to move forward to the next screen or press the ▼ key to return to the previous screen.
	Counter Channels < SELECT >	After viewing the Counter Channels settings, press the ▲ key to return to the Status screen.

WIND DATA LOGGER ADVANCED APPLICATIONS

This section of the manual includes advanced applications for the Wind Data Logger which may not be necessary for many users.

LOGGING INTERVAL SETUP

The logging interval prompts are used to set the frequency at which the Wind Data Logger records data to memory and resets the wind gust and count values. The default logging interval for recording data to the memory card is 60 seconds, which is suitable for most applications; however the logging interval can range from 10 to 60,000 seconds.

To change the logging interval, in the ***Main Setup Screen*** scroll to ***Log Interval Setup*** and refer to the appropriate section in the **CONFIGURATION AND OPERATION Table**.

SENSOR HOOKUP PIN-OUT INFORMATION

Non-standard sensors can be connected to the Wind Data Logger using the pinout information in **Table 2**.

	RJ-45 Pin	Wire Color	Anemometer Connector
Anemometer	1	Orange / White	Anemometer 0
	2	Orange	Anemometer 1
	3	Green / White	Anemometer 2
	4	Blue	Ground
	5	Blue / White	5 volts
	6	Green	Wind Vane 0 / Analog 1
	7	Brown / White	Wind Vane 1 / Analog 2
	8	Brown	Ground

	RJ-45 Pin	Wire Color	Temp & ADC Connector
Temp and ADC	1	Orange / White	Temperature / Analog 3
	2	Orange	Ground
	3	Green / White	5 Volts
	4	Blue	Analog 4
	5	Blue / White	Analog 5
	6	Green	Analog 6
	7	Brown / White	Analog 7
	8	Brown	Ground

Table 2. ***Pin-out information for* Anemometer *and* Temp & ADC *connectors.***

SENSOR ELECTRICAL INTERFACE

The Wind Data Logger employs analog low pass filters on all of its sensor inputs. The purpose of these filters is to reduce noise on the analog channels and to eliminate switch bounce on the anemometer / counter inputs. Simplified schematic representation of the four different input types and their filters is shown in **Figure 7**. Because of the pull up and pull down resistors on the inputs, the data logger requires a low impedance signal on all of its inputs. For example, a normal resistor voltage divider connected to an analog input would not give the same output as it would when measured alone by a digital volt meter. This is because 2.2k-ohm resistor at the input connected to 5 volts will load the voltage divider differently than the 10+ mega-ohm resistance of the digital multimeter. In some cases the pull up resistor can be used to your advantage. Simple resistive sensors, such as a thermistor, can be directly connected between the analog input and ground. The pull up resistor will work with the thermistor to form a voltage divider that is driven largely by the temperature of the thermistor.

Questions on sensor interfacing should be sent to APRS World's technical support department along with detailed specifications on the sensor desired to be interfaced.

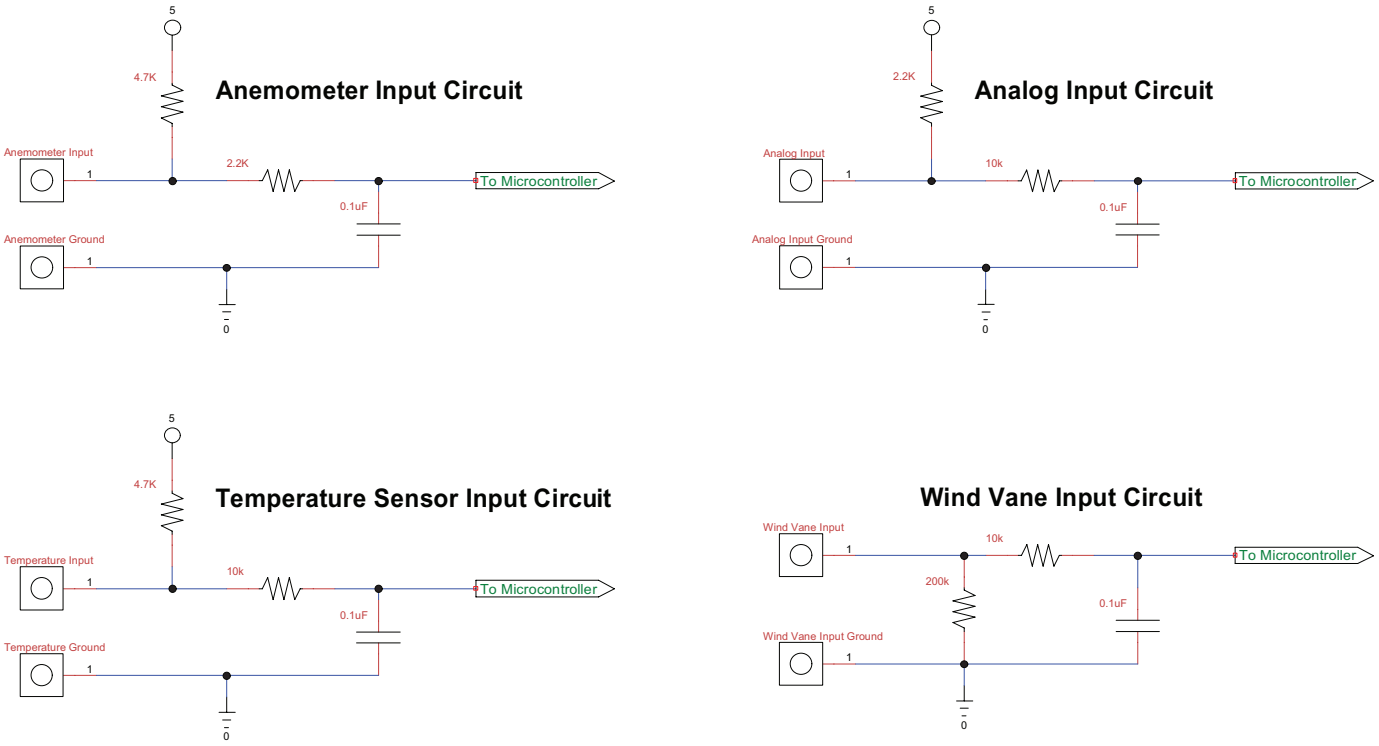


Figure 7. ***Input simplified schematics.***

RS-232 INTERFACE

The Wind Data Logger provides RS-232 level serial signals through a screw terminal connector. The connector is located in the middle of the Wind Data Logger circuit board and is labeled "RS-232" (**Figure 1**). The terminals accept 0.08 to 1.5 mm^2 (28 to 16 AWG) wire. The wire insulation should be stripped back 5.5 mm (0.21 in). You will need to supply the wire and connector(s) for your application. A #1 flat head (–) screw driver is needed to tighten the terminals.

There are a multitude of serial configurations in use, but the two most common configurations are for connecting to a computer and connecting to a communications device, such as a modem (**Table 3**). A handheld computer can be wired as either, so some research or experimentation may be necessary.

Data Logger Terminal	Description	Connect to a Computer (DTE)		Connect to a Modem (DCE)	
		DE-9	DB-25	DE-9	DB-25
TX	Transmit from data logger	2	3	3	2
RX	Receive to data logger	3	2	2	3
GND	Ground	5	7	5	7

Table 3. ***Data logger RS-232 serial configurations for connecting to a computer or modem.***

ANEMOMETER CALIBRATION

The Wind Data Logger's default settings are for the #40R Anemometer (APRS6504) and miles per hour (MPH). The data logger's anemometer settings can be calibrated in the ***Anemometer Setup*** menu (**Table 4**) within the Main Setup Menu. The data logger supports any anemometer with a contact closure or digital switch; however you will have to provide the calibration settings if they are not shown below. The data logger does not work directly with AC output anemometers.

Anemometer Type		Units	anemo_m	anemo_b
APRS World #40R Anemometer		miles per hour	0.857	0.725
		kilometers per hour	1.379	1.167
		meters per second	0.383	0.324
APRS World 6500 Anemometer		miles per hour	1.758	2.121
		kilometers per hour	2.829	3.413
		meters per second	0.786	0.948
NRG #40H Anemometer		miles per hour	1.711	0.780
		kilometers per hour	2.754	1.255
		meters per second	0.765	0.350
Richards Compact High Speed Anemometer		miles per hour	0.714	1.590
		kilometers per hour	1.149	2.559
		meters per second	0.319	0.710
Richards Compact High Speed Heated Anemometer		miles per hour	0.714	1.590
		kilometers per hour	1.149	2.559
		meters per second	0.319	0.710

Table 4. ***Wind Data Logger anemometer calibration values.***

CONVERTING ANEMOMETER PULSE COUNT TO AVERAGE WIND SPEED

Please note that the wind speed and wind gust readings are not averaged. The following instructions will enable you to find those averages. The ***Wind Pulses*** screen in the ***Main Display Loop*** shows the number of anemometer revolutions since the last write to the memory card. The pulse count information can easily be converted to average wind speed using the following formula, where the ***anemo_m*** and ***anemo_b*** values are obtained from **Table 4**.

Average Wind Speed = ((WCx/sample_interval) * anemo_m) + (anemo_b)

Note: This formula is not applicable for wind pulses (WCx) equal to zero.

Example using the following snippet of data from the data logger with an APRS World 6500 anemometer and a sampling interval of 60 seconds recording in MPH:

2007-07-14 00:01:53,18.0,19.4,810

As seen in the data snippet above or the reading from the data logger ***Wind Pulse*** screen, WC0 = 810. This information can then be used with the formula above:

Average MPH = ((810/60) * 1.758) + 2.121 = 25.85 MPH

where 1.758 is anemo_m and 2.121 is anemo_b for the APRS World 6500 anemometer in MPH.

USER ADC SETUP

The Wind Data Logger has eight analog input channels. One of these channels is dedicated to measuring data logger supply voltage. Two channels are configured and filtered for wind vane inputs, one channel for a temperature sensor, and the remaining four channels are available to the user for other sensors.

The analog inputs require signals that are in the range of 0 to 5 volts. In many cases the sensor or transducer linearally scales the parameter being measured. For example, the built in voltage sensor scales 0 to 40 volts to 0 to 5 volts.

To display and log meaningful data, the Wind Data Logger allows linear equations to be set for each of the eight analog channels. The linear equation consists of a scalar or coefficient and an offset. The scalar / coefficient is referred to as ***m*** and the offset is referred to as ***b***. The value that the Wind Data Logger displays and logs is calculated as:

value = m * voltage + b

Using the example of the built in voltage sensor, we have an ***m*** value of 8.0 and a ***b*** value of 0.0. Using those ***m*** and ***b*** values the data logger can convert the 0 to 5 volts it measures to the actual 0 to 40 volts it corresponds to. For example, if the data logger reads 2.5 volts it calculates

8.0 * 2.5 + 0.0 = 20

For on screen display, the data logger can have a short channel description and units associated with each channel. For the voltage sensor the default description is ***INPUT VOLTAGE*** and the units are set to ***VDC***. In summary, there are four values that are associated with each analog channel:

1.	**m (the scalar or coefficient)**
2.	**b (the offset)**
3.	**Label**
4.	**units**

The analog setup menu allows you to set these four values for each of the 8 available input channels.

DETERMINING m AND b FOR A GIVEN LINEAR SENSOR

Calculating the **m** and **b** values for a linear output analog sensor is easy when you have a spreadsheet available. You will need to know two output values of the sensor to calculate **m** and **b** (otherwise known as the transfer equation).

The easiest way to explain this process is with a demonstration. We will calculate the **m** and **b** values for the APRS6550 temperature sensor that comes with the Wind Data Logger Starter Package. By looking at the sensor data sheet we know that it outputs 0 volts at -273.15°C and 2.7315 volts at 0°C. Using the spreadsheet we set enter those values into two columns:

	A	B
1	**Temperature**	**Voltage**
2	-273.1500	0.0000
3	0.0000	2.7315

Once we have entered our values, we use the spreadsheets built in functions to calculate **m** and **b**.

A7 =SLOPE(A2:A3,B2:B3)

	A	B	C	D	E
1	**Temperature**	**Voltage**			
2	-273.1500	0.0000			
3	0.0000	2.7315			
4					
5					
6	**Linear Regression**				
7	100.0000	**Slope**			

A8 =INTERCEPT(A2:A3,B2:B3)

	A	B	C	D	E	F
1	**Temperature**	**Voltage**				
2	-273.1500	0.0000				
3	0.0000	2.7315				
4						
5						
6	**Linear Regression**					
7	100.0000	**Slope**				
8	-273.1500	**Intercept**				

Note that the Wind Data Logger only has built in support for handling linear sensors that use one channel. If you have a sensor whose output is non-linear or uses multiple channels, then you should log raw voltage and do your calculations on the logged data. A thermistor is an example of a non-linear sensor. Calculating power for voltage and current is an example of a sensor that uses multiple channels.

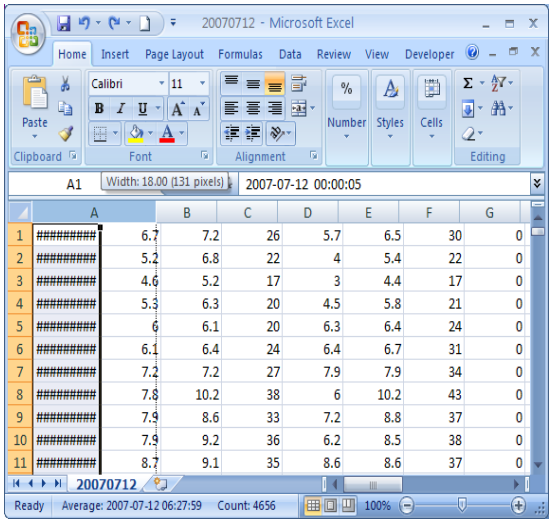
SERIAL DATA FORMAT

The Wind Data Logger sends each data record to the RS-232 port immediately after writing to the memory card. This record is in the same format as what is stored to the memory card. Each record is terminated with a \r\n (carriage return, line feed) sequence. The data is sent at the baud rate that was calibrated in the RS-232 Setup Screen. Data is sent as 8 bits, no parity, and 1 stop bit (8N1). No hardware handshaking is used. The serial port baud rate is set in the Main Setup menu ***Serial Port*** menu.

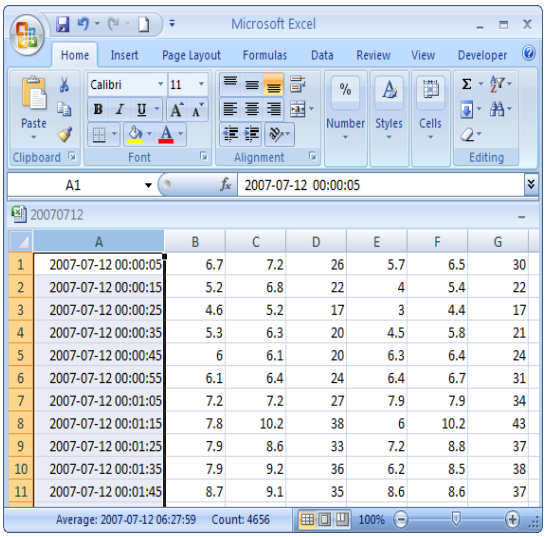
If you are developing parsing code, it is best to ignore any debugging messages which may begin with #. Normal records will contain only 0123456789,-:\r\n characters, where \r (ASCII 13) is a carriage return and \n (ASCII 10) is a line feed character.

CREATING A GRAPH IN MICROSOFT EXCEL

1. Launch Microsoft Excel and in the ***File*** menu, select Open. You may have to select the file type as ***text*** or ***all*** to find your file. Select the file you wish to analyze; you may have to tell Excel that it is delimited by commas.



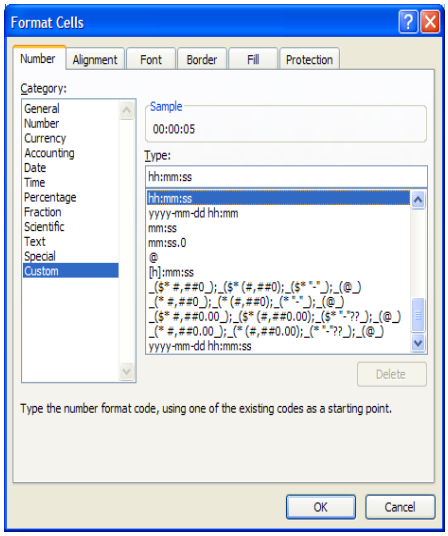
2. Upon opening the file, column ***A*** will display several ***#*** symbols. In order to get the date and time to display, expand the column ***A*** width by clicking and dragging on the column bar.



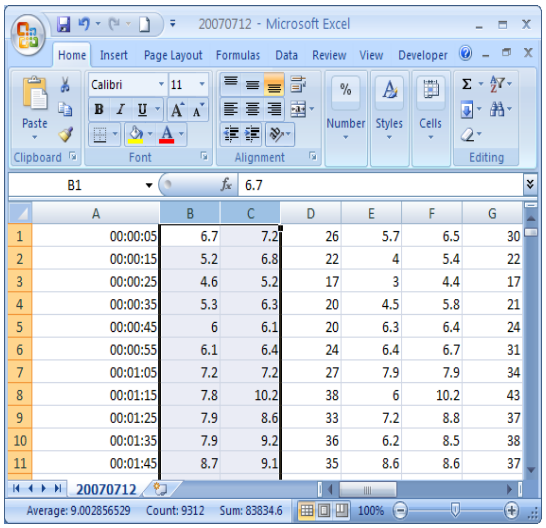
	A	B	C	D	E	F	G
1	2007-07-12 00:00:05	6.7	7.2	26	5.7	6.5	30
2	2007-07-12 00:00:15	5.2	6.8	22	4	5.4	22
3	2007-07-12 00:00:25	4.6	5.2	17	3	4.4	17
4	2007-07-12 00:00:35	5.3	6.3	20	4.5	5.8	21
5	2007-07-12 00:00:45	6	6.1	20	6.3	6.4	24
6	2007-07-12 00:00:55	6.1	6.4	24	6.4	6.7	31
7	2007-07-12 00:01:05	7.2	7.2	27	7.9	7.9	34
8	2007-07-12 00:01:15	7.8	10.2	38	6	10.2	43
9	2007-07-12 00:01:25	7.9	8.6	33	7.2	8.8	37
10	2007-07-12 00:01:35	7.9	9.2	36	6.2	8.5	38
11	2007-07-12 00:01:45	8.7	9.1	35	8.6	8.6	37

3. Right click on column ***A*** to highlight the entire data set in the column. A menu should pop up; in this menu, click ***Format Cells***.

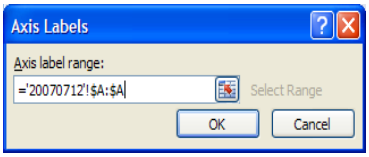
4. In the ***Format Cells*** screen, select ***Custom*** for the category and either scroll to or type in ***hh:mm:ss*** for the type. Column ***A*** should now display only the time.

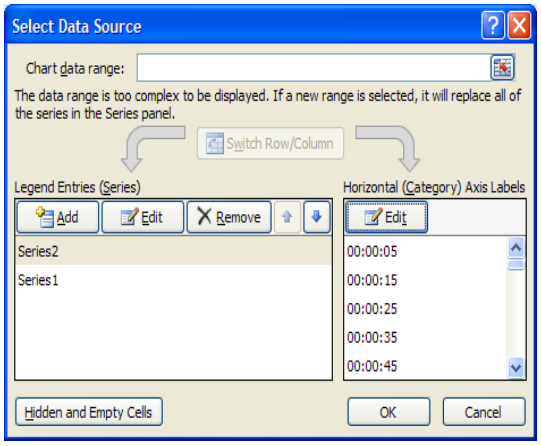


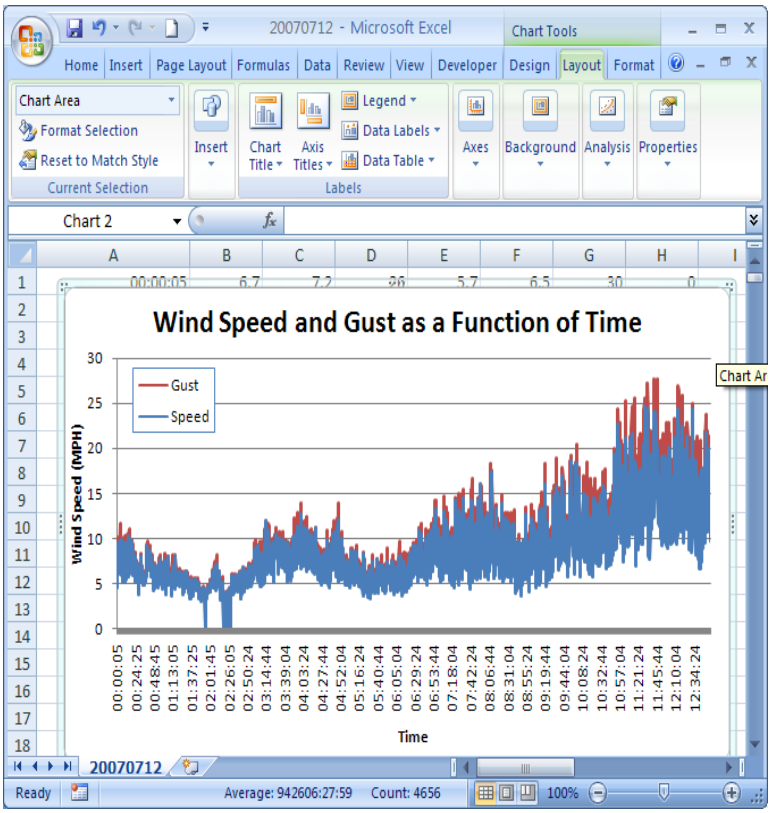
5. Select the data you wish to graph. Refer to the **Spreadsheet Field Description** section of the manual to view spreadsheet field and data format information if needed. In this example, we will analyze wind speed and gust from one anemometer (columns ***B*** and ***C***) over the course of a day. To do this, click and drag the cursor over columns ***B*** and ***C***. This should highlight all data in the respective columns.



6. In the ***Insert*** menu, go to ***Charts*** and create a line graph. Right click on the ***X*** (horizontal) axis of the line graph and click on ***Select Data***. Click ***Edit*** in the Horizontal (Category) Axis Labels box. An ***Axis Labels*** box should pop up allowing you to enter a range of times (i.e. column ***A***) corresponding to the data range you wish to chart.





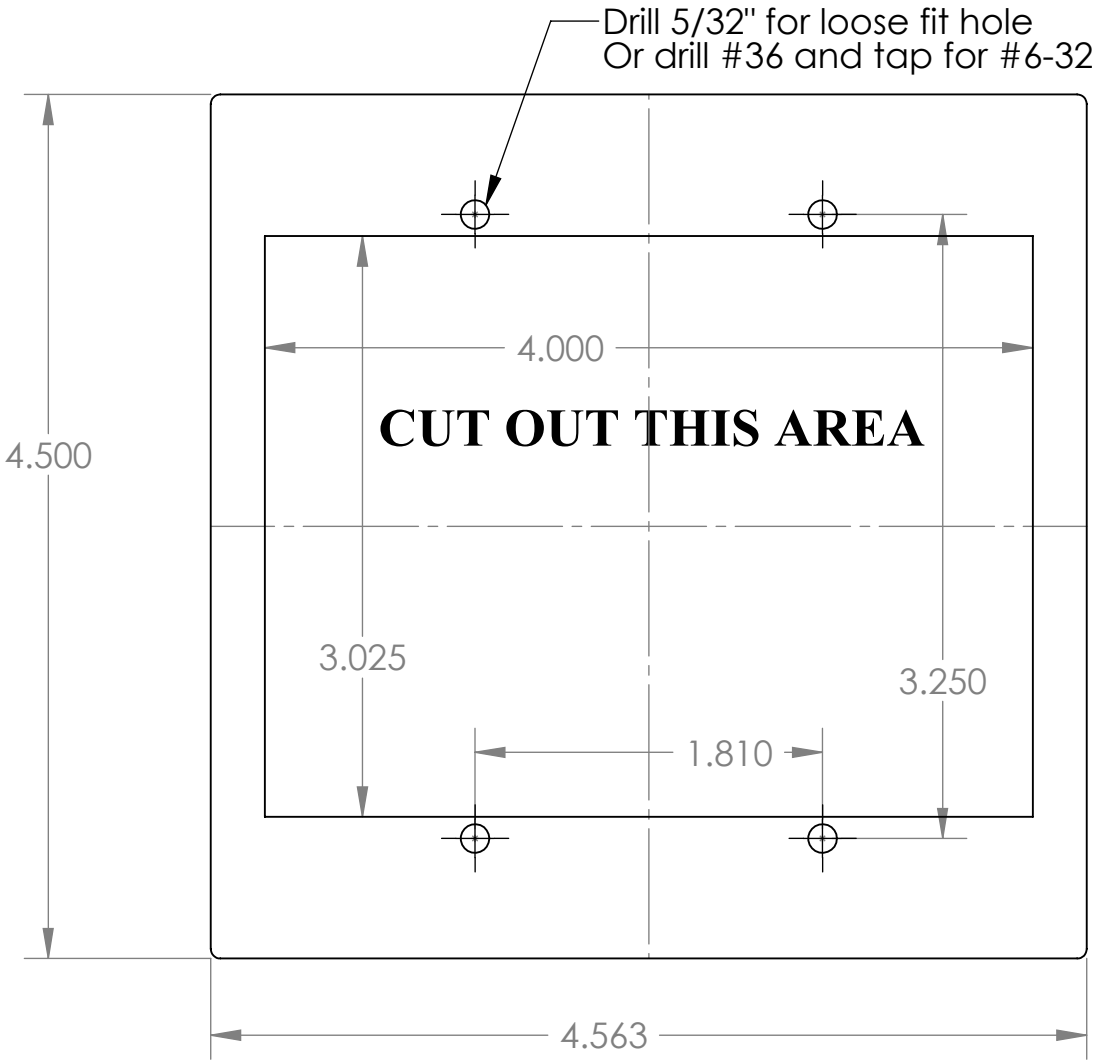


Click ***OK*** to return to the ***Select Data Source*** window; the ***Horizontal (Category) Axis Labels*** box should now display the times from column ***A***. Depending on your application, you may also wish to switch the series order or edit series name. In our application, it was necessary in order to differentiate between wind speed and wind gust. Click ***OK***.

WIND DATA LOGGER MOUNTING TEMPLATE

Additional copies of this diagram are available here:

http://www.aprsworld.com/wind2/documents/bezel_mounting_template.pdf



SPECIFICATIONS

SENSORS

ANEMOMETER

- Three digital anemometer inputs
- Supports dry contact switch, hall effect switch, or TTL level signal
- RC low pass filter on each input (fc=159 Hz)
- Inputs pulled to 5 volts with internal 4.7k resistor
- Capable of displaying and logging in miles per hour (MPH), meters per second (m/s), kilometers per hour (KPH)

WIND VANE

- Two analog inputs support either one dual wiper potentiometer or one single wiper potentiometer type wind vane
- Accessible through RJ-45 connector marked “ANEMOMETER”
- Displays 0° to 359°

ANALOG INPUTS

- Four channels
- 0 to 5 volt range
- 12 bit analog to digital converter, 1.22 mV precision
- Internal 5 volt 1% band gap voltage reference
- RC low pass on all inputs (fc=159 Hz)
- User configurable linear functions for displaying real units as well as voltage
- Accessible through RJ-45 connector marked “TEMP & ADC”

REAL-TIME CLOCK

- +-10 minutes per year accuracy
- Battery: CR1225 / BR1225, 3 volt lithium, 48mAh
- Battery life: 9 years minimum, 17 years typical
- Leap year compensation
- Accurate calendar until year 2099

INTERFACES

OPERATOR INTERFACE

- 16 character by 2 line LCD display
- Backlight with automatic or manual shutoff
- Adjustable contrast
- Three momentary buttons

LOGGING AND STORAGE

- Logs at 10 to 16,000 second intervals
- Secure Digital™ or Multi Media Card™
- Supports 2 gigabyte or smaller cards
- Data files in Comma Separated Vertical (CSV). Can be used with spreadsheet software, databases, or custom software
- One data file per calendar day

RS-232 INTERFACE

- EIA/TIA-232 voltage levels
- Four position screw terminals connector. Accepts 0.08 to 1.5 mm2 (28-16 AWG) wire. Strip length, 5.5 mm (0.21 in)
- 1200, 2400, 4800, 9600, 19200, 57600, and disabled baud rates, 8 bits, no stop bit, 1 parity bit (8N1)
- No hardware handshaking
- Accessible through connector marked “RS-232”
- Outputs raw data logger record in same format as written to memory card
- #1 flat screw driver required

ELECTRICAL, MECHANICAL, AND REGULATORY

POWER

- 8 to 32 volts DC
- 2.1 x 5.5 mm power jack

- 50mA peak power while writing to SD card
- 35mA with backlight on
- 15mA with backlight off
- All sensors inputs have Transient Voltage Suppression (TVS) protection

MOUNTING

- Mounts into double gang electrical box or custom panel
- Includes four stainless steel #6-32 x 3/4 in mounting screws and four stainless steel #6-32 lock nuts
- #2 Phillips (+) screw driver required

WEIGHT AND DIMENSIONS

- Weight: 136 gram (4.8 oz)
- Overall Dimensions: 116 mm wide, 114 mm tall, 37 mm deep (4.55 x 4.5 x 1.475 in)
- Dimensions behind bezel: 96 mm wide, 70 mm tall, 33 mm deep (3.775 x 2.765 x 1.285 in)

MATERIALS

- Bezel: Aluminum, powder coated with printed polycarbonate overlay
- Circuit boards: FR-4, 1.6mm (0.062 in), double sided, plated through holes, solder mask, silk screen
- Hardware: stainless steel and Nylon

REGULATORY COMPLIANCE

- RoHS compliant, no lead used in manufacture