AIM Quick Start Guide

Sept 26, 2011

LOADING THE SOFTWARE:

The AIMuhf/AIM4170/PowerAIM software does not require a formal installation procedure. It does not interfere with any other programs or the registry on your computer.

1) Create a folder or a subfolder on any convenient hard drive.
For example, "*C:\AntennaAnalyzer*". (the name can be anything)

2) Download the latest program from the website:
 http://www.w5big.com/prog_update.htm

The latest program is shown at the top of the page.

3) Save the zip file in the folder you just created for the antenna analyzer software and documentation. Unzip it in this folder or another folder if you wish.

4) The file labeled "AIM_xxx.exe" is the executable file. It is ready to run without going through an installation process. When later versions of the program are released, the number "_xxx" will be different. All versions of the antenna analyzer program can reside in the same folder at the same time. The older programs with the lower numbers will not interfere with the newest version, so they do not have to be deleted.

Be sure your computer displays the **extensions of files** so you can distinguish the *.exe files from the other files. See Appendix 5 for more information.

5) The same program will run the **AIMuhf**, the **AIM4170** and the **PowerAIM**. It automatically determines which instrument is connected when it starts to run. It is important to turn on the hardware before starting the program.

If you want to make a shortcut icon for your desktop, right click on the AIM_xxx.exe file (or the latest version) and select "create shortcut" from the dropdown menu. Drag the shortcut to your desktop or task bar.

HARDWARE CONNECTIONS:

Plug in the DC power supply (8 to 12V at 500 ma recommended) and insert the connector into the jack on the rear panel of the analyzer.

Press the power switch. The Green LED will blink a few times to indicate the version of software and then remain on continuously. The Red LED is on only when a measurement is in progress.

To turn off the power, press the power switch again. If the analyzer does not receive a command from the PC for 10 minutes, it will power down automatically if it is in the AutoPwrOff mode. The AutoPwrOff mode can be turned on/off with a menu selection under the **Setup** tab at the top of the screen.

The AIMuhf/AIM4170 can be operated on battery power for remote operation with a laptop computer. The current required is about 350-400ma while a measurement is in progress and about 50ma when idle.

Batteries are not included with the AIMuhf/AIM4170 but you can make a battery pack using any type of batteries you like. There is room *inside the case* for a 9V battery and disconnect diodes are included so the battery and the AC power supply will not interfere with each other. There is also a space for an optional resistor to use for trickle charging a battery, if desired. The main power on/off switch controls the battery power too, so the leakage current is less than one microamp when the AIMuhf/AIM4170 is turned off. Refer to Appendix 6 and the Application-Help file for more details

When using the AIMuhf/AIM4170 to test a mobile antenna on a motor vehicle, it is better to use a separate battery and **not** the 12V battery in the vehicle. A 9V battery will power the unit for several hours or a small 12V gel cell (sealed lead acid) battery can be used for extended operating periods. This avoids the problem of sneak paths through the ground between the DC power input and the antenna ground connection. It will also help reduce measurement noise if it's necessary to run the engine while taking data (such as to operate the air conditioner). **If it's essential to get power for the AIMuhf/AIM4170 from the vehicle, be sure to put 500 ma fuses in BOTH the +12V lead and the power ground lead.** A small voltage drop across the fuses will not affect the AIMuhf/AIM4170 since the battery voltage is much more than the required minimum operating voltage. The laptop computer being used should remain **floating** for the best measurement accuracy.

When using the AIMuhf/AIM4170 with a new antenna system, check the AC and DC voltage between the antenna ground and the ground used for the AIMuhf/AIM4170 and the PC. This voltage should be less than 1V. A balanced antenna should have a DC connection to ground through a balun or RF choke on one side (or both sides). Of course there should always be a large resistor (or balun) connecting both leads of the antenna to a ground path in order to drain off static electricity.

NOTE: Before connecting a transmission line to the input of the AIMuhf/AIM4170, be sure to momentarily short its pins together to drain off any static charge that may be present. Also, be sure there is no DC voltage on the antenna. If there is DC, use a blocking capacitor between the AIMuhf/AIM4170 and the antenna input.

Antennas and transmission lines can have enough static charge to damage sensitive electronic equipment. This can happen even when there is no rainstorm in the area.

A strong wind can generate static charge. So can just flexing a coaxial cable by rolling it up or unrolling it, even if there is no antenna connected to it.

An antenna or a component to be measured should not be connected or disconnected from the analyzer <u>while a test is in progress. A test is in progress when the RED LED is on</u>.

<mark>Be sure the maximum input voltage at the DC power connector does not exceed 15 volts. The minimum input voltage required is 6.0 volts</mark>.

<u>**NOTE:**</u> Low cost power supplies that plug in the wall are usually not regulated and their maximum output when no load is connected may be several volts higher than their rated output. **Check the output voltage with no load to make sure it does not exceed 15 volts**.

Power supplies that operate on a wide input voltage range such as 120V to 220V use a switching regulator. Evaluate the measurement results to see if noise from the power supply may be a problem.

<u>**PC INTERFACE CABLE:**</u>

Connect one end of the **RS232 cable** to the antenna analyzer and the other end to COM1 on your PC. If you want to use a different COMM port, start the AIMuhf/AIM4170 program and click on the **Setup** menu at the top of the screen. Then click on **Enter Comm Port** and enter the port number that you want to use. This number will be saved in the setup file called *AIM_xxx.ini*.

If you are connecting to the RS232 port with a USB adapter, you will need the appropriate driver. An adapter based on the FTDI chip is recommended, especially with Win 7. For additional information on the usb port, refer to this document: w5big.com/PC_USB_INTERFACE.pdf

If you have a USB adapter that you have been using, it should be ready to run.

Initial Operation:

Launch the AIM_xxx.exe program. You will see a graph similar to this:
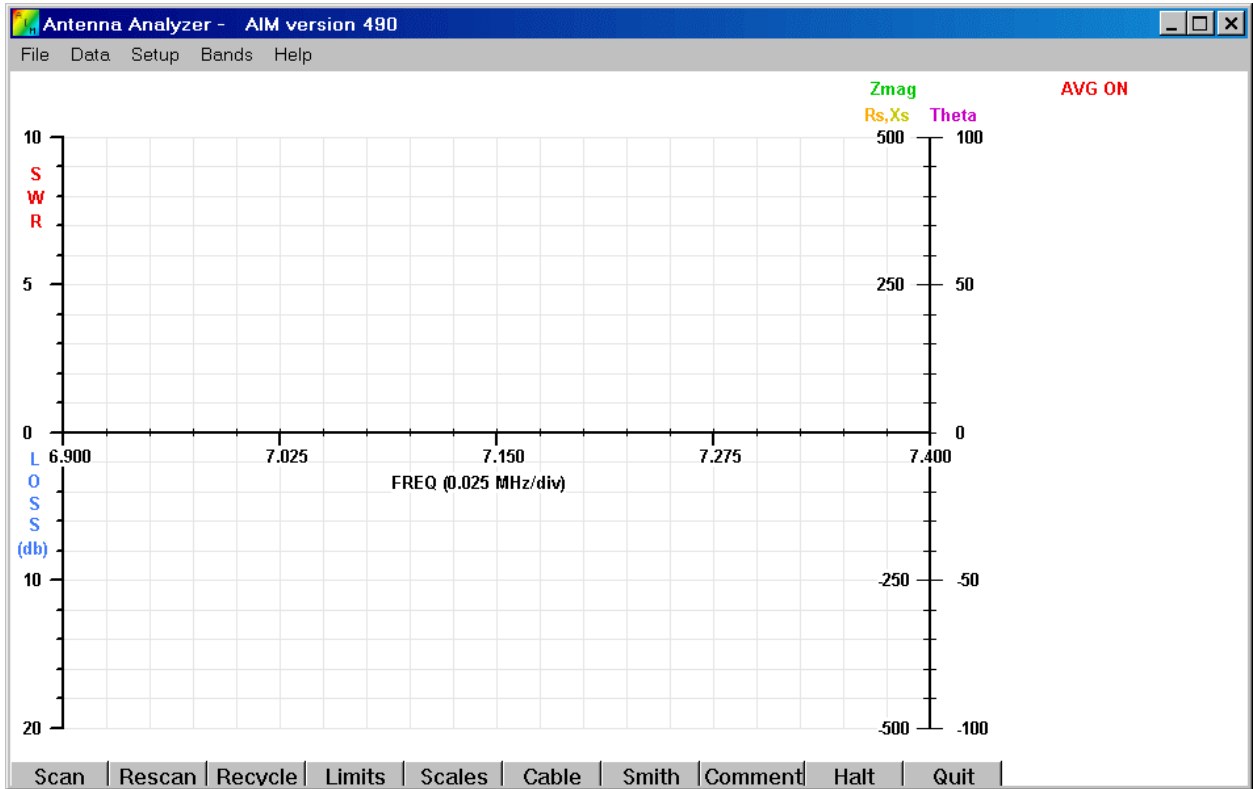
When the AIMuhf/AIM4170 is present, it must be turned on **before** the PC program is launched.

If the PC program starts when the AIMuhf/AIM4170 is not connected and powered up, the program will automatically enter the DEMO mode. In the demo mode, you can look at previously saved scan files.

For a quick test after calibrating, leave the calibration resistor connected to the RF connector and click the **SCAN** button in the lower left corner of the screen.

The Red LED will come on while the scan is in progress. A blue bar will move across the top of the graph as the scan progresses.

You will see a set of traces (similar to the picture below). The actual values are not important, but this shows the AIMuhf/AIM4170 is functioning.

Antenna Analyzer - AIM version 490

File   Data   Setup   Bands   Help

Min SWR = 5.98958 @ 6.97000 MHz
Resonant freq: 6.91261 , 6.94761 , 6.95185 , 6.96902 , 6.97085 , 7.04893 , 7.05572 , 7.07840

Zmag (green) **Rs,Xs** (orange) **Theta** (magenta)   **AVG ON**

FREQ (0.025 MHz/div)

06-01-06 17:11:42

Scan | Rescan | Recycle | Limits | Scales | Cable | Smith | Comment | Halt | Quit

Freq = 7.064
Zo =50

SWR = 6.012
Zmag = 300.607
Theta = -0.146

Refl Coef = 0.715
% refl power = 51.1
Return Loss = 2.92 db

Short/Open Circuit:
Cable Loss = 1.46 db

Equivalent Circuit:
Rs = 300.606
Xs = -0.765
Cs = 29460.181 pF

Rp = 300.608
Xp = -118152.017
Cp = 0.191 pF

Scan using a 301 ohm resistor for a test load.

Antenna Analyzer -

Files Functions Calibrate

Load Graph
Save Graph
Swap Graphs
Save Image BitMap
Print
Load Calibration File
Load Config File
Save State
Recall State
DC Power Off
Quit

Calibrate Setup Markers Bands

Standard Cal 0.25-1000 (1.0)
Custom Cal

Hi Res Cal 0.1-1000 (0.5)
BC band 0.1-2.1 (0.01)
HF band 0.2-60 (0.2)
VHF band 40-160 (0.5)
UHF-1 band 140-500 (0.5)
UHF-2 band 400-500 (0.25)

✓ Auto smoothing (2%)
Manual smoothing
Smoothing OFF

Voice Output
SWR Tone

Setup Markers Bands

Plot Parameters
Plot styles   ▶
Plot Offset Values   ▶
Ruler 1   ▶
Ruler 2   ▶
✓ Label Traces
Enter Zo Ref
Velocity Factor
Average reading...
Smoothing   ▶
Recycle Depth
Enter Comm Port
Find Comm Port
✓ Cursor Normally ON
✓ Grid Highlight
Audio Out   ▶
Auto Power Down
Dynamic Scan Rate
Morse

SWR (Q,Rho,L,C)
Zmag
Rs
Xs
Theta
Return loss
Legend
Clear all styles

Zmag
Theta
Rs
Xs
Return Loss
✓ Offsets ON/OFF
✓ Labels ON/OFF
Clear All Offsets

Avg OFF
Avg 4
Avg 8
Avg 16
Avg 32
Avg 64
Avg 128
Avg 256

SWR 1
Theta 1
Zmag 1
Rs 1
Xs 1
Return Loss 1
Rulers ON/OFF
Clear All Rulers

Markers Bands Utilities TDR Help

Markers
Rotate Smith Chart
Polar Plot   ▶

Display Marker Data
Theta Rotation
Toggle Markers
Clear All Markers
Save Markers
Recall Markers

SWR
Z
S11

Bands Utilities TDR

Highlight Bands
Band Skip
160_METERS
80_meters
60_meters
40_METERS
30_METERS
20_METERS
17_METERS
15_METERS
12_METERS
10_METERS
6_METERS
2_METERS
BAND_A
BAND_B
BAND_C
BAND_D

Utilities TDR Help

L-C Matching Networks
ZPlots Data Analysis
Twelfth-wave Matching

TDR Help

TDR Mode on/off
✓ Linear Z Scale
Show Rho Scale
✓ Lines/Dots
Velocity Factor
Meters/feet
High Resolution

Help

AIM Manual
Applications
Edit Config File
Status
Check for Prog Update
About

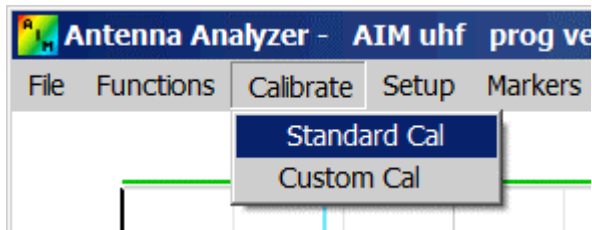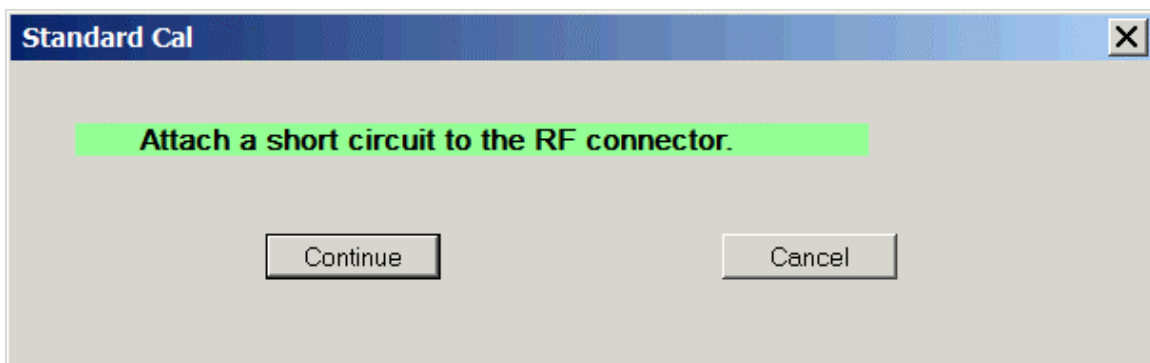| Scan	Rescan	Recycle	Point Data	Limits	Scales	Smith	Comment	Halt	Quit

Calibration

The AIMuhf/AIM4170 have **no internal adjustments**. There are no trim pots or caps inside. All the calibration is done with the following software procedure.

Click on the **Setup** menu and select **Standard Cal**.

A message box will appear near the center of the screen, as shown below:

Attach the connector with an internal short circuit (this is included with the AIMuhf/AIM4170, it has a green label and is labeled "short").

After the short circuit is in place, click **Continue**.

The program will run for a few seconds to take several reading of the **short circuit**.

Sometimes when calibrating with a coax stub or an external filter connected to the AIM RF port, the impedance may appear to be significantly difference from a short circuit at 1MHz and a message will appear asking if this is a valid condition. If the connections are correct and you really do want to continue with the special external hardware hooked up, click YES. Otherwise, click NO to abort the cal procedure. Then after connecting the desired load, restart the calibration.

Then it will display a message box, shown below:

Standard Cal

Attach an open circuit to the RF connector.

Continue   Cancel
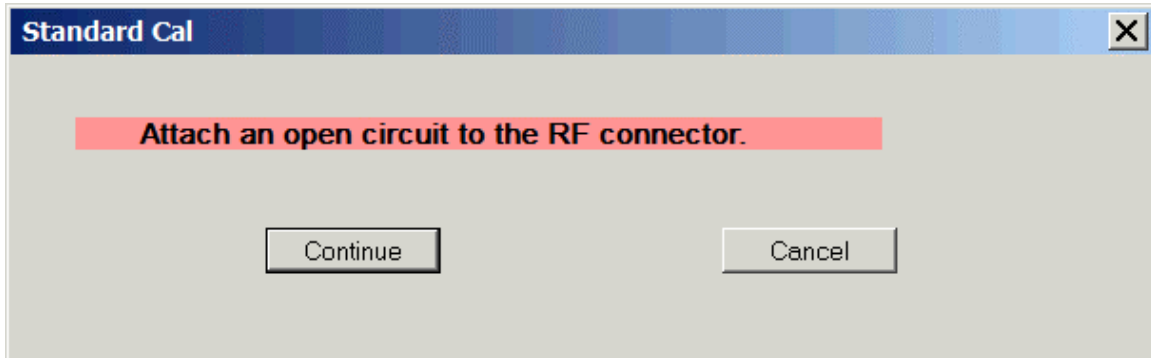
Replace the short circuit with an **open connector** (this has a red label and is included with the AIMuhf/AIM4170) and then click **Continue**.

The program will run for a few seconds to take several readings of the **open circuit**.

For the best accuracy, especially at VHF frequencies, use an **open connector** of the same type that is used for the **short circuit**. This allows the program to compensate for the stray capacitance of the connector itself. For example, 3 pF of stray capacitance due to a BNC connector represents a reactance of about 1K ohm at 50MHz which will appear to be in parallel with the load. This will seriously affect readings at higher frequencies if it is not properly compensated. Therefore, the three calibration devices (open, short, resistor) should be carefully constructed so they have similar stray capacitance and inductance which will be cancelled out by the calibration procedure.

NOTE: If you are using the UHF/BNC adapter (or another adapter) leave it on the output connector of the AIMuhf/AIM4170 when calibrating the ***open circuit****. In this way, the capacitance of the adapter itself will be included in the calibration process.*

For example, If you want to use a BNC-to-binding post adapter, calibrate the short circuit with a **jumper wire** across the binding posts. Then remove the wire and calibrate the open circuit condition with the adapter still attached. This procedure cancels the stray capacitance of the adapter and you can get accurate readings of discrete components attached to the binding posts.

The calibration procedure can also cancel the effect of a piece of coax that is used as a jumper to connect the AIMuhf/AIM4170 to the load. In this case, the open, short and standard resistor are connected to the far end of the jumper. Good results have been obtained with as much as two feet (60 cm) of jumper coax.
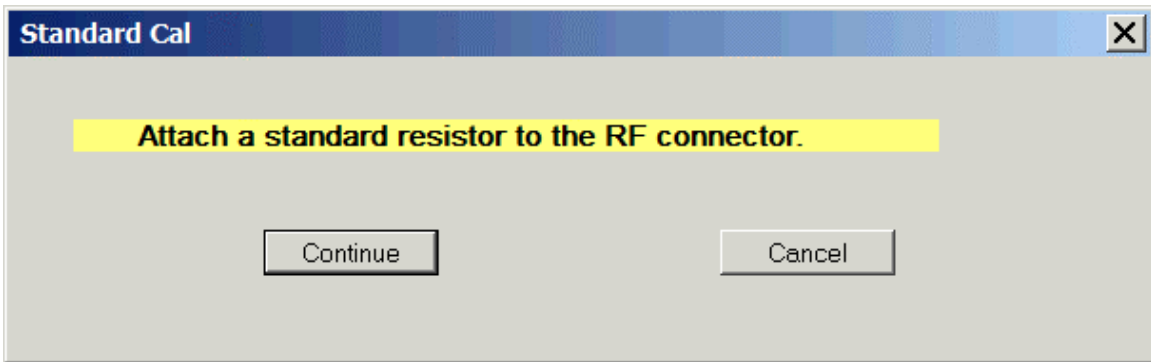
After taking several reading of the open connector, the program will prompt for the standard resistor with a value between 50 ohms and 500 ohms. This resistor typically has a yellow label and it's included with the AIMuhf/AIM4170 kit. If you want to cal with a different resistor, the exact value is not critical. Enter the value you measured with a digital ohmmeter and click Continue.

After reading the standard resistor, the Red LED goes off and the prompt for a calibration data file name appears:
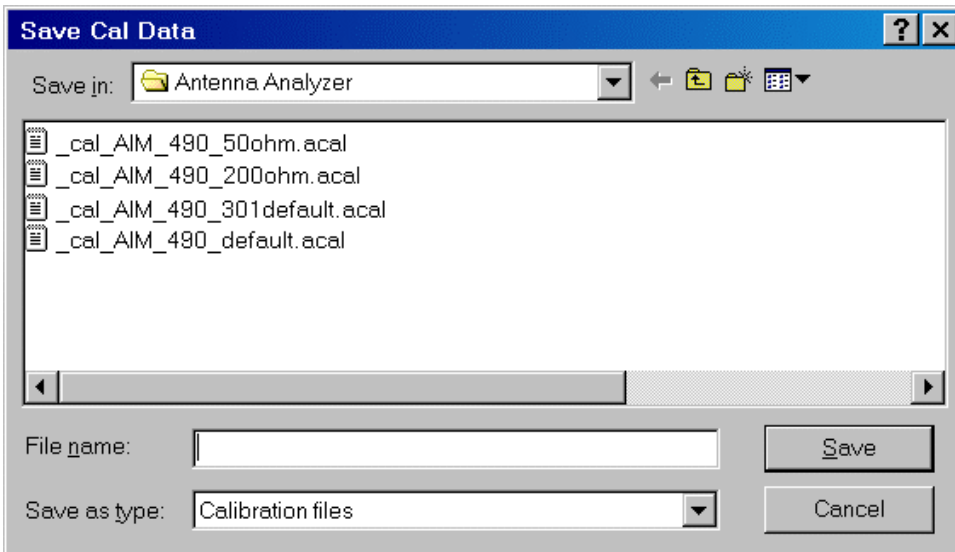
Enter the name of the calibration file and click "Save". There is no restriction on the name of the cal data file. It's extension is automatically set to .acal ("**a**nalyzer **cal**"). Any of these cal files can be recalled latter using the menu option "File" → Load Cal File.

Then the cal complete message box is displayed as shown below:
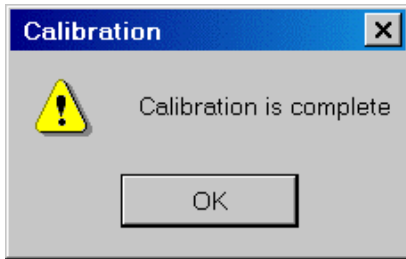
Click **OK** to continue.

Each time the AIMuhf/AIM4170 program starts, the last calibration file that was used will be read to restore the cal data. Any number of calibration files can be saveed and recalled using the **Files** menu.

Since there are no adjustments that have to be made inside the case, the calibration is very stable.

This completes the calibration procedure. Now you are ready to begin testing your antenna.

Appendix 4 – RS232/USB Operation

Because some newer computers don't have RS232 ports, it may be necessary to use an RS232 to USB adapter with the AIMuhf/AIM4170. The AIM's RS232 port uses only three wires. Pin 2 is the data from the AIM to the computer, pin 3 is the data from the computer to the AIM and pin 5 is ground. Hardware handshaking is not used. The signal amplitude on the I/O lines (pins 2 and 3) is approximately +/-5V.

If the comm port assigned to the USB adapter is not known, try using the "Find Comm Port" command under the "Setup" menu. This will scan from comm 1 to comm 64 to find which port is working. The comm port assigned to the USB adapter can also be found using the Windows Device Manager: Click Start → Settings →Control panel → System → Hardware → Device Manager.

If there seems to be a problem with the USB adapter, here are some tips for checking it.

When the AIM first powers up, it sends out a character string that can be received by any **terminal emulation program**, such as **HyperTerminal**. To use HyperTerminal, which is a standard accessory in Windows, click on the **Start** button in the lower left corner of the Windows desktop. Then, click "Programs" -> "Accessories" -> "Communications" -> "HyperTerminal". Set HyperTerminal for the following parameters:

 Baud rate=57600; 8 data bits; 1 stop bit; no parity; echo typed characters locally.

When HyperTerminal is ready, turn on the AIMuhf/AIM4170 power. The green LED on the AIM front panel will flash and the text displayed on the computer terminal is the following (or similar):

Antenna Analyzer AIMuhf/AIM4170
from Array Solutions
 Oct 13, 2006

If this is displayed, it means the data from the AIM to the computer is okay.

To check data from the computer to the AIM, type **K1 (K** and a one). Note the **K** is **upper case**. The command **K1** will cause the AIM to turn on its Red LED. There is **no character space** between the **K** followed by a **1**, but the time interval between typing the **K** and the **1** is not critical. Then, type **K0** (K followed by a zero). The Red LED should go off. This indicates the AIM is able to receive commands from the computer; therefore, the I/O data link is working properly.

revised: Dec 28, 2010

Appendix 5 – File Extensions

Windows has an option to not display the extensions of some files. This makes it hard to distinguish files with the same names but different extensions. Be sure this option is **<u>not</u>** enabled.

The following images show the dialogs that appear in Win 7. The phrase "Hide extensions for known file types" is used in other versions of windows too.

Folder Options   ☒

General | View | Search |

┌─ Browse folders ──────────────────────────────────────┐
   🖼️   ⦿ Open each folder in the same window

         ○ Open each folder in its own window
└──┘

┌─ Click items as follows ──────────────────────────────┐
   📄   ○ Single-click to open an item (point to select)

           ○ Underline icon titles consistent with my browser

           ⦿ Underline icon titles only when I point at them

       ⦿ Double-click to open an item (single-click to select)
└──┘

┌─ Navigation pane ─────────────────────────────────────┐
   📁   ☑ Show all folders

   📁   ☐ Automatically expand to current folder
└──┘

                     [Restore Defaults]

How do I change folder options?

          [OK]   [Cancel]   [Apply]

Folder Options ✕

General | View | Search

Folder views

You can apply the view (such as Details or Icons) that you are using for this folder to all folders of this type.

Apply to Folders   Reset Folders

Advanced settings:

- Files and Folders
  - ☐ Always show icons, never thumbnails
  - ☑ Always show menus
  - ☐ Display file icon on thumbnails
  - ☑ Display file size information in folder tips
  - ☐ Display the full path in the title bar (Classic theme only)
  - Hidden files and folders
    - ○ Don't show hidden files, folders, or drives
    - ⊙ Show hidden files, folders, and drives
  - ☑ Hide empty drives in the Computer folder
  - ☐ Hide extensions for known file types
  - ☑ Hide protected operating system files (Recommended)
  - ☐ Launch folder windows in a separate process

Make sure this item is NOT checked.   Restore Defaults

OK   Cancel   Apply