Overview

This chapter provides an overview of YESDAS Manager and its main features.

What is YESDAS?

The *Yankee Environmental Systems Data Acquisition System* (or YESDAS-2) was initially developed by the US Department of Energy for performing large scale power usage audits at hundreds or even thousands of homes across the United States. YESDAS-2 is essentially a sophisticated multi-channel A/D with a memory buffer behind it. Highlights include:

- An auto-calibrating analog front end that is table over time and ambient temperature
- High analog input channel count (32 analog, 6 pulse counters)
- Data processing takes place on a workstation with YESDAS Manager—data are *never* altered by the YESDAS-2 hardware itself. This means you have total control over correction and calibration of all data, and data can later be re-processed with new calibration constants.
- Fully weatherproof enclosure with self-contained high quality linear AC power supply
- Supports industry standard RS-232 communications devices, e.g. Hayes-compatible modems
- Supports multi-platform data processing tools: PC DOS, MS-Windows 9x/NT, Apple Macintosh, and Unix or Linux
- All acquired data are tagged with a system-unique hardware serial number to support automated data quality control checks during data processing

Although YESDAS-2 has several features not found in other data loggers, its analog data accuracy over time and temperature is a key feature. In the mid 1990's YES commercialized this government-developed measurement technology as the YESDAS-2 family of data logger and control systems.

Description of YESDAS Manager

YESDAS Manager V2.0 is a comprehensive tool set for MS-Windows 9x/NT that fully automates communication, data processing, data display and configuration management for the YESDAS-2 data logger and control system. It is designed to fill the needs of the meteorologist, climatologist or scientist requiring high accuracy and reliability of monitored environmental parameters. Because it automates nearly all steps in the data collection and calibration process it frees you from tedious day-to-day repetitive tasks such as collecting and calibrating data, permitting you to focus more of your time to data analysis and interpretation.

YESDAS Manager supports the Microsoft Windows 9x/NT operating systems and includes these major components:

- A YESDAS Network Management facility referred to as the *YESDAS Explorer* that enables you to administer and organize setup information and data associated with one or more YESDAS-2 data logger and control systems. This facility automatically performs data file and directory management such as data concatenation into orderly *midnight-to-midnight* day files
- A fully integrated terminal emulator that you use to communicate with YESDAS-2 over a serial or modem dial up link.
- An *Automated Attendant* that reliably retrieves data from one or more remote YESDAS-2 sites without human intervention. The Attendant also continuously watches for and logs any YESDAS-2 hardware error conditions and processes raw collected data into calibrated data.
- A data analysis component called the *Data Manager* lets you analyze data previously collected from YESDAS-2 or in real time, as long as an active serial connection is available. Data can be viewed both as calibrated or uncalibrated, raw A/D counts.
- A configuration management system integrated within the *Data Manager* client that keeps the calibration and solar information files synchronized with any new YESDAS-2 configuration changes. These changes are tracked in objects known as system *profiles*.

Features and Enhancements

YESDAS Manager v.2.0 includes many major enhancements to earlier MS-DOS tools and many completely new features that help you administer a single YESDAS-2 or a network of systems:

- YESDAS Manager's MS-Windows 9x/NT compliant graphical user interface (GUI) client is called the *Data Manager*. This window appears when you are browsing the data with local data display functions, including calibrated plots. If an active serial connection is available to the remote YESDAS-2, live *real time* calibrated data display is supported on the local the PC.
- Within YESDAS Manager's *YESDAS Explorer* you can view your YESDAS-2 network organized by site in a familiar MS-Explorer-like graphical tree view. If you're running only one YESDAS-2, then you have a single site with one YESDAS-2 below that site. However, if you're managing multiple YESDAS-2 systems, either at the same or different sites, the *Explorer* view lets you easily control and browse the data from all sites. YESDAS

Manager's object-oriented design lets you create communication profiles and then shares these resources among all systems in your network.

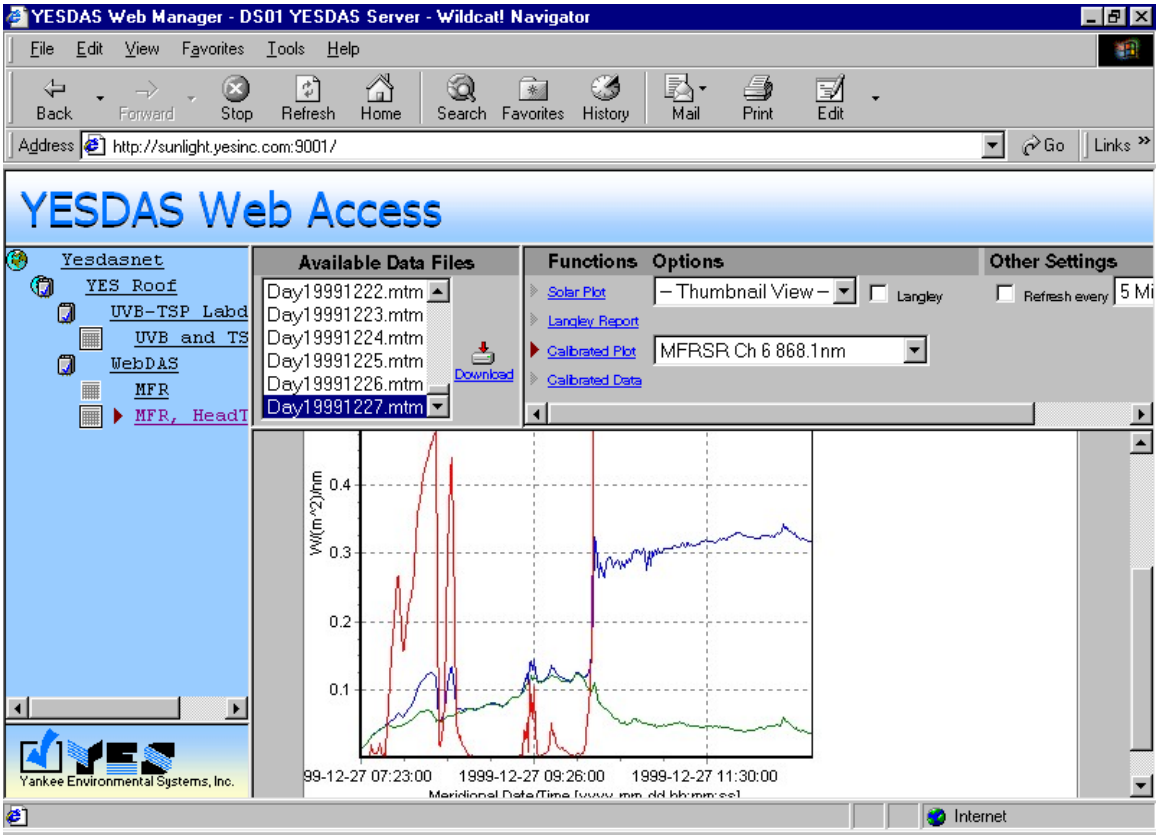
- Normally, you manage one or multiple sites as a "one-to-many" relationship. However, multiple YESDAS-2 data acquisition and control systems may exist on the same remote phone line at a site (e.g. a MFR-7 and a UVMFR-7 via a tone -operated telephone line switch). YESDAS Manager permits you to provide shared access to data from a network of multiple sites, effectively creating a "many-to-many" relationship.
- Two password levels in the YESDAS-2 hardware permit control over who has access over changing the data acquisition protocol. For example, professors could be given the supervisor password to be able to alter site sampling profiles via YESDAS Manager while students might only be allowed to retrieve and view data. YESDAS Manager eliminates the need for users to have passwords by providing data access via a Web Server.
- A system tray component, the *YESDAS Attendant*, performs schedule-driven file retrieval in the background and checks for error conditions as it retrieves data. YESTalk/DOSBand did not provide this functionality. As anyone who has tried to use a computer to send data over the telephone network knows, there are reliability problems inherent with the technology. Modems mysteriously drop connections, and data are garbled by random line noise, requiring human intervention. The data collection (or *polling*) engine is driven by a sophisticated scheduler with agents that can be spread across several PC workstations to handle the collection of multiple remote sites simultaneously. As data files are gathered each one is automatically checked for truncation or other common transmission errors. A retry is performed if any errors are encountered. If all data unpacks successfully, the memory buffer in the remote YESDAS-2 system can be optionally cleared if desired to reduce data overlap and lower communications charges.
- YESDAS Manager's built-in communication facility (formerly known as YESTalk under DOS), is fully integrated with the Data Manager and uses your existing MS-Windows communication resources, such as modems and their serial port settings. In most circumstances it is not necessary to even interact with the communications facility as all operations are automated via

the Attendant. The communications facility buffers the user from the control language YESDAS-2 uses and permits multiple serial ports to be active at a time. This permits, for example, a site with a local direct-wired YESDAS-2 to simultaneously collect data from another remote site connected via modem on a different port while it displays real time data from the local system. That is if a modem connection or direct serial connection is left active, YESDAS Manager can display real time data. The YESDAS Web Server can then publish this data in near-real time to users over the Internet.

- The Harrison Objective algorithm that performs automated pre-filtering of Langley data from direct-normal measurements, has numerical enhancements over earlier DOSBand codes to improve the accuracy of optical depth retrievals, especially under marginal conditions of high turbidity.
- YESDAS Manager fully integrates all data file management and organization for you, so you do not have to manually keep track of data files. However, YESDAS Manager will also start by double-clicking on any existing **.xmd** binary data file you want to work with.
- Managing any site for an extended period of time can create a large data file repository. As binary data files are collected by the data collection engine a data merge facility converts these files into contiguous "midnight-to-midnight" .**mtm** day data files and organizes them into easy to follow directories. This merge eliminates any redundant or overlapping data sets if the YESDAS-2 data buffer was not cleared after each download. It also watches for other problems such as wide time gaps or configuration errors in the data stream, by performing a low level quality control check of the data acquisition protocol. (All **.xmd** and **mtm** files are fully compatible with legacy Unix-based YESDAS data tools such as ***callang*** and ***tu***). Also, a YESDAS-2 hardware system-unique identification serial number in each binary data file supports a further automated quality control check. This check ensures that the remote system being polled actually belongs to the set of solar information and calibration information data files.
- YESDAS Manger introduces the concept of system *profiles* to track and manage data acquisition protocol changes to each YESDAS-2 system over its operational lifetime. Profiles keep track of important changes in the data stream as sensors are periodically added or replaced with freshly calibrated sensors. For example, profiles effectively create controlled calibration epochs that permit later automated processing of the data using the correct calibration constants. The power of the underlying QED algebraic data processing language that governs YESDAS Manager's data processing can be tapped via the new QED editor.
- The standalone *YESDAS Web Server* component presents YESDAS calibrated data to Internet or Intranet users as a Web user interface (WUI) via conventional web browsers as shown below. Either Netscape 4.04 (or later) or MS-Internet Explorer 4 (or later) browsers as supported The WUI permits you to push data to remote users via Internet, Intranet or virtual private network TCP/IP connections, leveraging your investment in LAN technology. Remote web users need only a web browser; they do not need special client software. They can even use a simple cut-and-paste of the URL from the browser to transfer data from the YESDAS Manager Web Access

directly into favorite MS-Windows applications such as MS-Excel for further analysis. Also, because multiple YESDAS Manager client licenses do not need to be purchased and maintained, this feature permits "low administration" operation of large networks of YESDAS-2 systems, dramatically lowering the total cost of ownership. The Web Server component can also be installed on another PC to partition the workload.

- To support publishing data to the web, the PC will need a full time connection to the Internet to permit others to browse the Web server component, therefore, installation of this component is optional. (DOSBand did not provide this functionality.)



YESDAS Manager's Web Server Web User Interface (shown under MS-Internet Explorer 5).

- YESDAS Manager is fully backward-compatible with both **.xmd** and merged midnight-to-midnight **.mtm** YESDAS-2 binary data files as well as **.cal/.sol** calibration/solar information configuration files. If you are upgrading from the DOS tools you will need to ingest your data files onto YESDAS Manager. Once integrated, you can present data to other users via the web server.

- The tools formerly known as YESTalk and DOSBand for the most part did not provide much of this new functionality; for example they did not provide automation of data collection, web access to the data, profiles, real time graphical data display or calibrated data graphical display.

How it Works

YESDAS Manager is a multi-threaded, 32 bit MS-Windows 9x/NT application that takes advantage of OS features such as virtual memory, and shared printer and communications resources. It is designed to be flexible enough to work within the cooperative multi-tasking environment of the MS-Windows 95 operating system, permitting you to use your PC for other tasks at the same time. The software actually consists of three distinct subsystems:

- A date and time-driven YESDAS Automated Attendant that acts as an agent to retrieve data from remote sites on a schedule, and handles problems such as communication drop outs by notifying you via email alerts. The attendant resides in your system tray. It automates all standard daily functions such as processing raw data into calibrated data.
- A self-contained YESDAS Web Server component that independently publishes retrieved calibrated data to users via the http protocol over the Internet's world wide web.
- A Central Data Management facility, called the YESDAS Data Manager, that features a tightly integrated terminal emulator and profile manager to track any system configuration changes you make as you operate your network.

These three subsystems are designed to work together and to permit partitioned deployment across multiple Windows 9x/NT PC workstations. In this way each subsystem can be scaled to support very large networks of YESDAS-2 systems.
YESDAS-2 hardware communicates via a RS-232 serial connection and a terminal emulator. It uses a unique command-line language to control and modify its operational parameters. The YESDAS-2 control language has a strict syntax for each command—see your *YESDAS Installation and User Guide* for more details on how these commands are used. It insulates you from having to learn these commands and also fully automates daily collection and reporting duties.
As it collects data files, YESDAS Manager processes binary data files into non-overlapping "midnight-to-midnight" day files that are then angle corrected, calibrated and displayed locally via the Data Manager. Data are also available via the world wide web via the YESDAS Web Server. Users with Web browsers can view it graphically, download ASCII data, or even cut-and-paste the URL into MS-Excel to rapidly import it into that spreadsheet.

Installation

This chapter covers the details of installing and setting up the various software components for the first time. It is assumed that you have a basic familiarity with your operating system as well as your current YESDAS-2 hardware configuration. If you have not done so, review your *YESDAS Installation and User Guide* first to familiarize yourself with the basics of how it works. The installation process is highly automated and uses a familiar *wizard* install program to setup the system. If this is a brand new system installation, your YESDAS-2 hardware system was provided with a companion default calibration and solar information data diskette. The YESDAS Manager install wizard reads data files from this disk to self-configure your initial profile with minimal user intervention.

If this is a platform software upgrade to an existing DOSBand/YESTalk you will need to first create a DOS diskette with a copy of your current calibration information and solar information files (**.cal** and **.sol**). The YESDAS Manager install wizard will read these files during the installation process and guide you through a set of questions such as active channels and sampling rate that will then create your system's channel profile. Because your existing YESDAS system may use non-default values for sampling, and may have other auxiliary sensors configured, you will need to instruct the install wizard exactly how many channels to initialize and how frequently to take data. You will want to review and record your current system configuration before you run the install wizard.

Before running the install, decide whether you will install the web server component. It is a recommend install as it provides a Web User Interface (WUI) to view collected data, although it is not mandatory for non-networked PCs. However, even on non-networked PCs where there is no chance to share data with users via the Internet, the WUI provides a fully-automated "self-service" interface to processed YESDAS data, and provides a simple path to importing data into MS-Excel. Even if you do not plan to share data with others via the web, the Web server provides other important functionality such as the ability to remotely view data and diagnosis misalignment problems.

During the install you will physically connect YESDAS-2's serial port either directly to a open COM/serial on your PC via the null-modem cable, or via modems if it is located remotely. This will verify that the communications hardware is functioning properly.

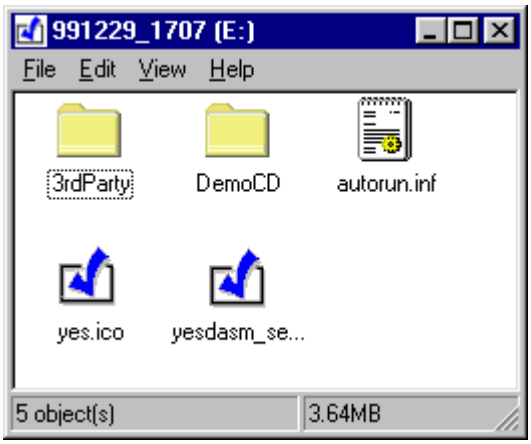
The YESDAS Manager install path involves working through the

- YESDAS Wizard Setup (including communication test)
- Attendant Setup
- Web Server Setup

Hardware and Software Requirements

YESDAS Manager can be installed locally on a PC that is used to communicate with the datalogger or on a local area network. Network servers are typically are backed regularly by MIS/IT personnel while PC workstation drives are often not backed up, or backed up infrequently. However, if the server connection is ever lost (due to server downtime, etc) the network server mapped drive will be lost and the Automated Attendant will not be able to write to the mapped server data directory when it performs its scheduled downloads. For this it is recommend that you install the software locally and configure you backup software to performs automatic backup of your local PC data drive.
YESDAS Manager requires a minimum configuration of:

- MS-Windows 95, 98 or Windows NT with at least 10 Mb of free disk space (additional space is required for data files).
- Pentium 200 MHz or faster CPU
- 32 MB of RAM is recommended in order to run YESDAS Manager and YESDAS Web Server concurrently, 64 Mb under MS-Windows NT 4. You may be able to run with as little as 16 MB of memory, but swapping will occur and performance will be degraded.
- Netscape/AOL Navigator 4 , or Internet Explorer 4 (or later version) web browser installed to access data from the YESDAS Web Server



Typical CD-ROM MS-Explorer view

How to install YESDAS Manager

If you are installing from a CD-ROM or floppy disks, insert the CD-ROM or floppy into the appropriate drive. If it is a CR-ROM, simply await the MS-Windows Explorer window; otherwise if you are installing from floppy disks use MS-Explorer to browse and open the drive. Double-click on the *yesdasm_setup.exe* file located on the CD-ROM or floppy disk 1. Click on the Setup button when the install self-extractor dialog appears. Review the software license agreement.
The installation program is a *wizard* program that walks you through the installation process—just follow the instructions on the screen. A similar wizard is invoked each time you create new items such as sites within YESDAS Manager.
For your convenience, this document is also supplied in Adobe PDF format on the CD-ROM. Viewing this file requires the installation of the Adobe Acrobat Reader, and a copy

of this viewer is on the CD-ROM. You can also check at http://www.adobe.com for the most recent version of the PDF viewer.

Important: The calibration and solar information files (**.cal** and **.sol** files) shipped with all new YESDAS-2 systems are required to open and analyze data collected by a YESDAS-2. If you have recently purchased your YESDAS system it was supplied with a separate floppy disk containing these files. However, if you are upgrading from DOSBand, you will need to know the location of your current **.cal** and **.sol** files, or copy them to a floppy disk. When you run the install wizard, it will prompt you for the directory they are stored in or a floppy disk containing them. For upgrades, you can browse to a directory where these files are located. YESDAS Manager uses the original **.cal** and **.sol** file set as a basis for a new set of calibration files to match the new profile. Once these files are read into the system, future YESDAS channel configuration (or *profile*) changes will create a new pair of files to support that configuration setup.

Note: Although you can alter the default program install location, it is recommended that you follow the instructions of the setup program accepting most default values such as program location. This way it will be easier to follow this documentation if the installation path remains at the suggested path:

```
C:\Program Files\YesInc\Yesdasm
```

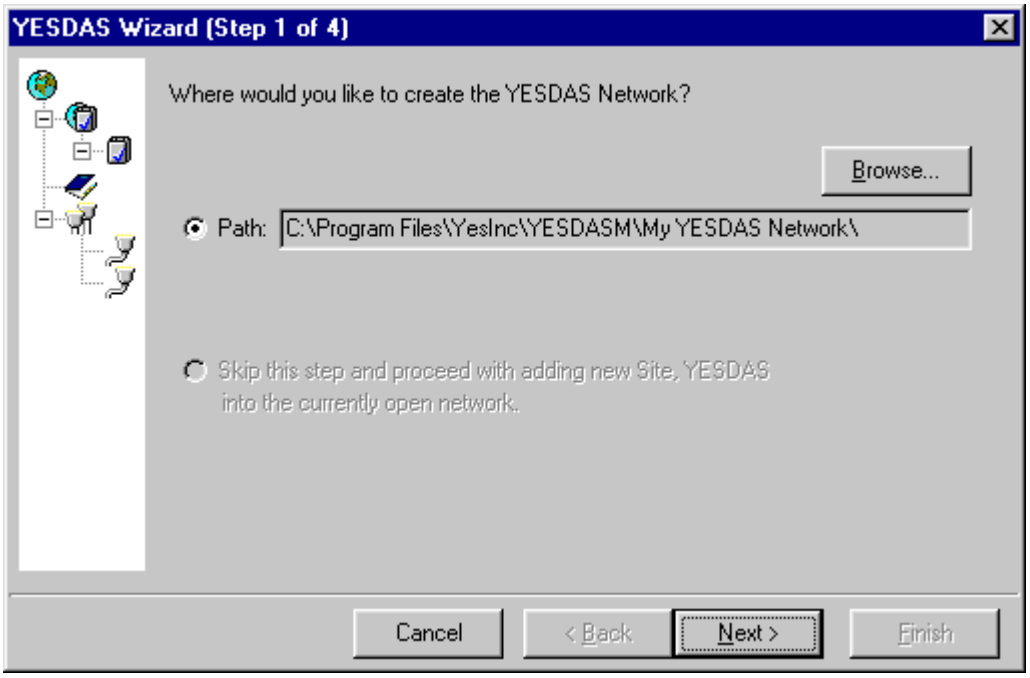
Finally, if you install the Adobe PDF viewer, you may wish to refer to the YESDAS Manager Online Documentation. The Online Documentation is always accessible through the “Start Menu”, “Programs”, “YESINC – YESDAS Manager”, “YESDAS Manager Documentation”.

YESDAS Wizard Setup

Once the software is copied to your PC, you should proceed directly with defining a YESDAS network using the YESDAS Wizard.

1. If it is not already running, start YESDAS Manager from the Start menu by selecting Start>Programs>YESINC-YESDAS Manager>YESDAS Manager.

2. Select File> New to create a new YESDAS network. The path to the data files can be changed to your preferred location using the Browse button.

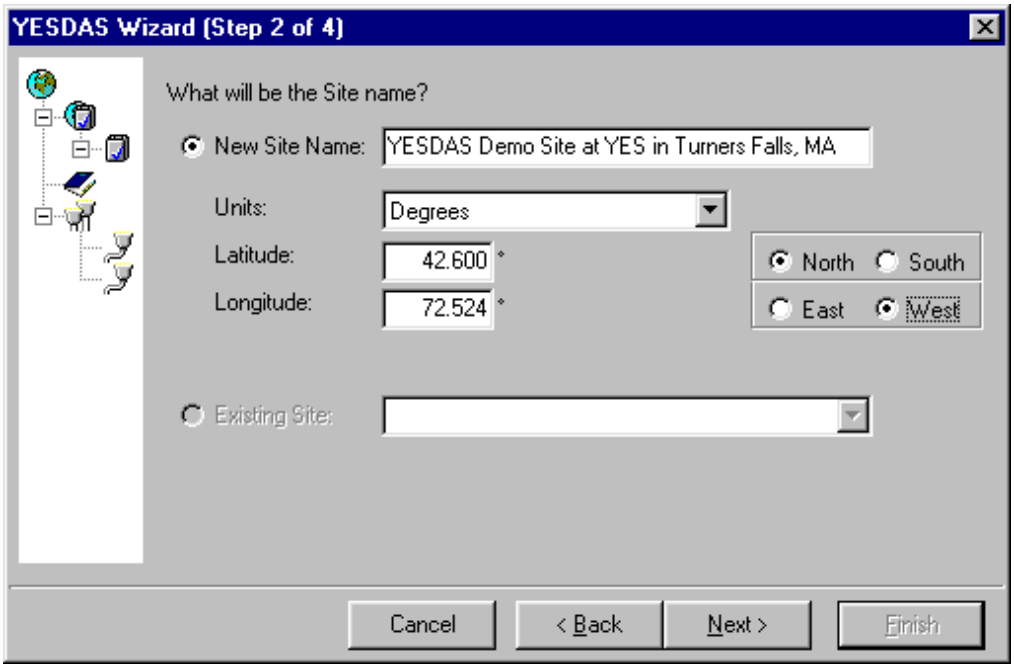


3 Specify a working directory for the network in the Path field. The path name is also the network name that appears in the YESDAS Explorer window. If you are installing over a pervious version of YESDAS Manager, you must use the same install location to preserve your data files. Make a note of this directory location as your data directories will reside beneath it.

4 The default name for the network is *installation-directory\My YESDAS Network*. You should rename *My YESDAS Network* to something more meaningful such as the name of your monitoring project. In this example, the network name is *yesdasdemo*. To change the name, select the Browse button. Then type the name of the directory or select it from the list. If you type the name of a directory that does not exist, the wizard creates it automatically.

5 Note: the Path field is grayed out (and the second option is active) if a network is already open in your YESDAS Manager main window. In this case, the wizard allows you to create a site in the existing network or Cancel the operation. You must close the current network before you can create a new one, as YESDAS Manager only works with one network at a time.

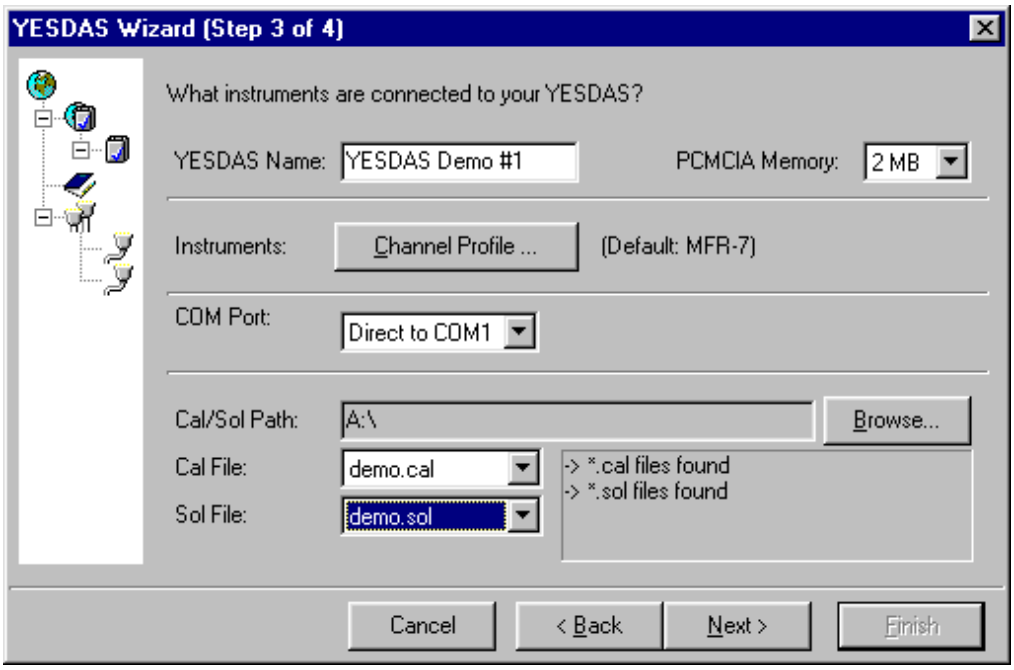
6 Select the Next button to go to the next step in the wizard.



7 Specify a site name and the location of the site. Be sure to indicate whether the site is North or South of the equator and East or West of Greenwich, England using the radio buttons.

Important: The latitude and longitude must be accurate to about 1/100th of a degree in order for YESDAS-2 to properly calculate the position of the sun at your site at all times. If these values are not correct, or the instrument is not aligned to geographical north/south (*not* magnetic north/south), your shadowband shading will not work correctly.

8 Select the Next button to go to the next step in the wizard.

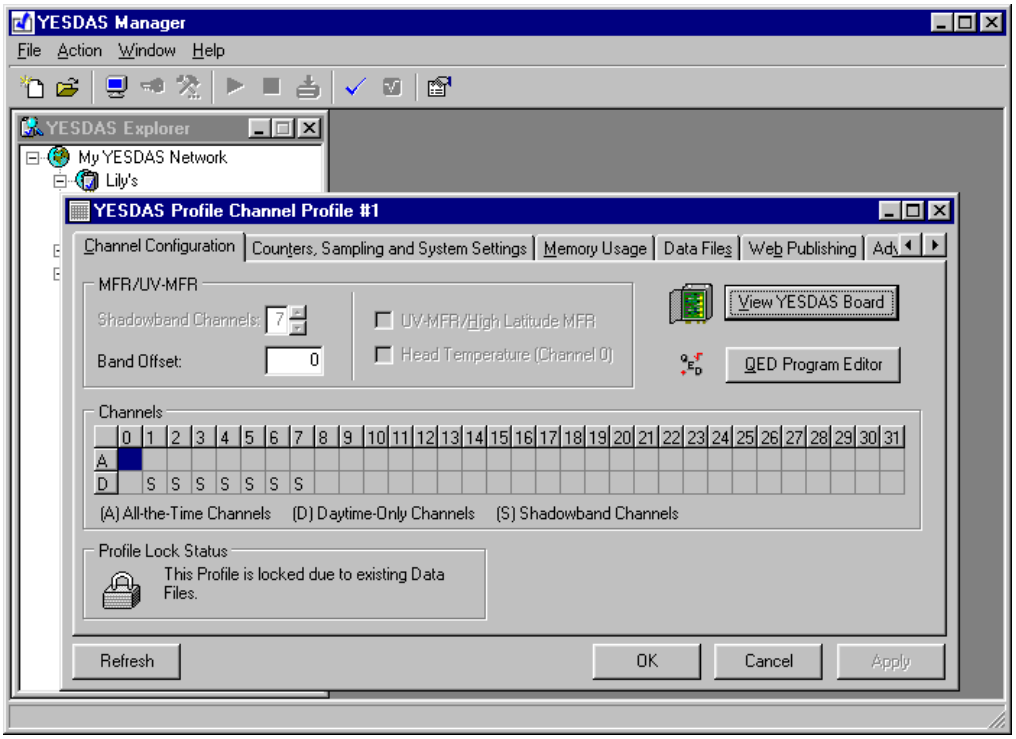


9 Specify details about the YESDAS system in this window:

- **YESDAS Name.** You can specify any name for your YESDAS. You may want to include the YESDAS serial number or head ID in the name for identification purposes.
- **PCMCIA Memory.** If the PCMCIA Memory Card Option is installed in your YESDAS, indicate the size of the card. *Otherwise, without the PCMCIA option all YESDAS systems have 32kB of memory*. This option is used by YESDAS Manager only—the YESDAS hardware will automatically recognize and use the memory card regardless of the value specified for this option. In addition to using the value to calculate the estimated time to full function, YESDAS Manager uses this option when you run the Receive Data command. If a card value is specified, YESDAS Manager uses the T 2 command to download data; otherwise, it sends the T 1 command, which downloads data from the 32K buffer only.

  Important: You must choose the correct size of your PCMCIA Memory Card Option if one is currently installed. If you are not sure of the size review the *YESDAS PCMCIA Memory Card Option Installation and User Guide* for instructions on determining the card size.

10 **Instruments.** By default, the system assumes a seven-channel shadowband instrument (MFR-7 or UVMFR-7) is connected to your system. To modify this configuration, select the Channel Profile button.



11 On the Channel Configuration window, notice that the number of shadowband channels is 7 and, by looking at the Channels grid, you see that the shadowband channels (denoted by an S) are sampled during the daytime only. To turn off shadowband channels, click on the down arrow alongside the number of channels or just type 0 in the field.

12 Indicate whether you have a UVMFR-7 or high-latitude MFR-7 or SDR-1 connected by selecting the check box. This affects the maximum allowable sampling rate limit.

13 To turn on other auxiliary channels, click button 1 in the appropriate row: A for All-the-Time or D for Daytime-Only. Alternatively, type A or D in the desired cell in the grid. Click on the cell again to turn off the channel. Note that for shadowband systems, YESDAS channel 0 is configured to monitor the head temperature of the shadowband instrument. By default, this channel is not turned on. You can monitor the head temperature during the daytime only or all the time by turning on Channel 0.

14 Indicate whether any counter-type instruments are connected to YESDAS. For each counter, you can select a scaling factor.

15 Select OK to accept the changes and return to the Wizard window.

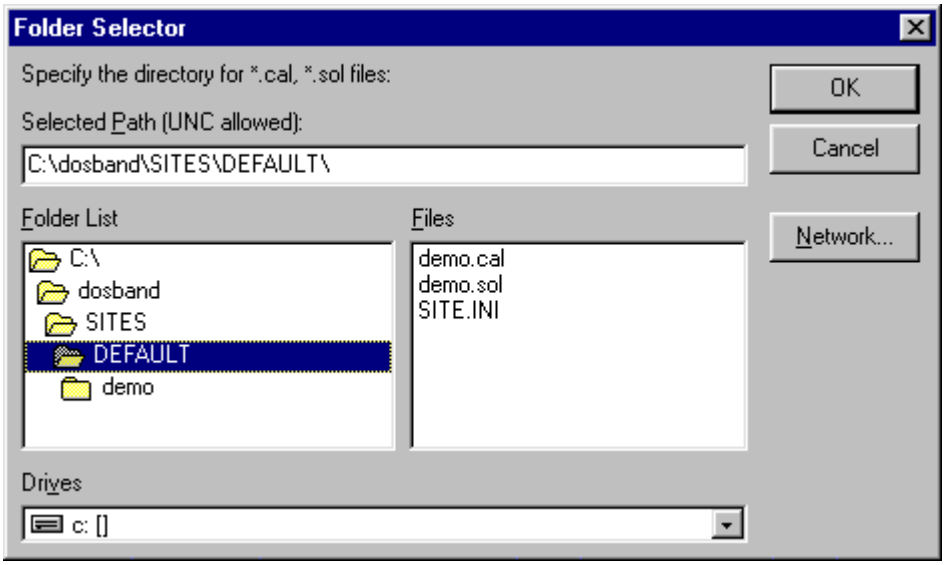
Important: Each time you make a change the YESDAS channel configuration, you must update your **.cal** and **.sol** files to reflect these changes via the QED editor as described in the chapter on QED later in this document. Otherwise, YESDAS Manager will not be able to automatically process data collected by the YESDAS Attendant, as it cannot perform angular corrections or apply calibation constants. However, if you make changed the profile from within YESDAS Manager the system will keep the files **cal** and .**sol** files synchronized with the profile. We suggest that you start with these defaults and experiment with changes once you have the system up and collecting data.

16 **Com Port.** Select the serial communication port you will use to connect to YESDAS. The available ports come from your Windows system settings. You can see how they are configured by selecting the MS-Windows Start > Settings > Control Panel > System > Device Manager > Ports. Refer to your MS-Windows documentation for more information on configuring ports.

Note: If you're testing the YESDAS-2 system communications indoors or just outside your laboratory first (as recommended), you probably have a local computer connected over the supplied 9 pin to 9 pin RS-232 null-modem cable provided. In this case, you should select the COM port that the null-modem cable is connected to. Later, when the system is deployed in the field, you will want to create another Communication profile that uses a modem to connect to YESDAS. Always use a straight RS-232 cable (not supplied) to connect YESDAS-2 to a modem.

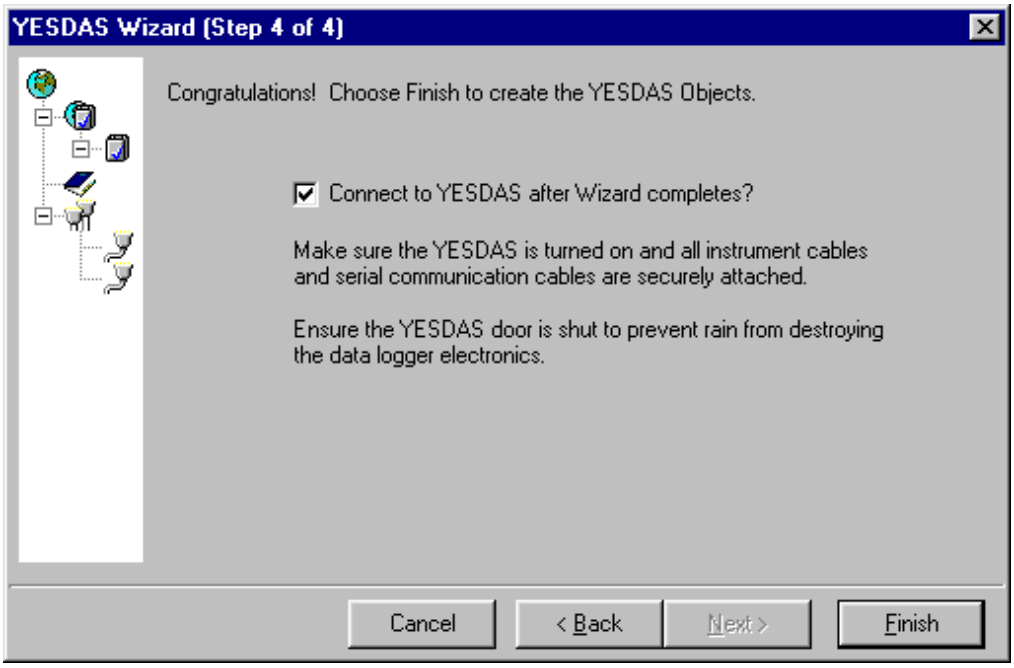
If you are not sure which COM port is which on your PC , try looking in Control panel via Start > Settings, then click on the icons *Modems* and *System* (Look at Device manager, then select Ports).

17 **Cal/Sol Path.** If you received YESDAS Manager with new YESDAS-2 hardware, locate and insert the supplied floppy disk labeled "MFR###" where ### is your system's hardware serial number. This disk simplifies the following steps because the install Wizard will automatically detect the presence of default system settings that match your hardware, and you can skip the Instrument's setup button (that will be disabled if the program detects that you have inserted the MFR### floppy disk.) If you did not insert the disk before the install wizard started, you can simply choose Back and Next buttons again to have the install Wizard detect the floppy. However, if you purchased YESDAS Manager separately or are upgrading from an earlier version, specify the location of the directory your current **.cal** and **.sol** files are located in that belong to your current YESDAS-2 system. The default path is **a:\.** so if this is a new system, simply insert the diskette containing the **.cal** and **.sol** files in the floppy drive. YESDAS Manager displays any files it finds with these extensions in the corresponding fields on the Wizard window. Select the correct **.cal** and **.sol** files from the drop-down list. If you're working with an existing system, select the Browse button to change the Path to the location where the existing **.cal** and **.sol** files reside.



18 Type the path name or select it from the Folder list. If you type the path name, you can use the Microsoft Universal Naming Convention (UNC) format, which allows you to type a machine name (or host or server) followed by a share name (or volume name) and then the folder name; for example, **server1\volume1\folderdemo**. As you click on folders, all files in that folder appear in the Files list box. When you return to the Wizard window, you can select the **.cal** and **.sol** files; you do not select them from the list on the Folder Selector window.

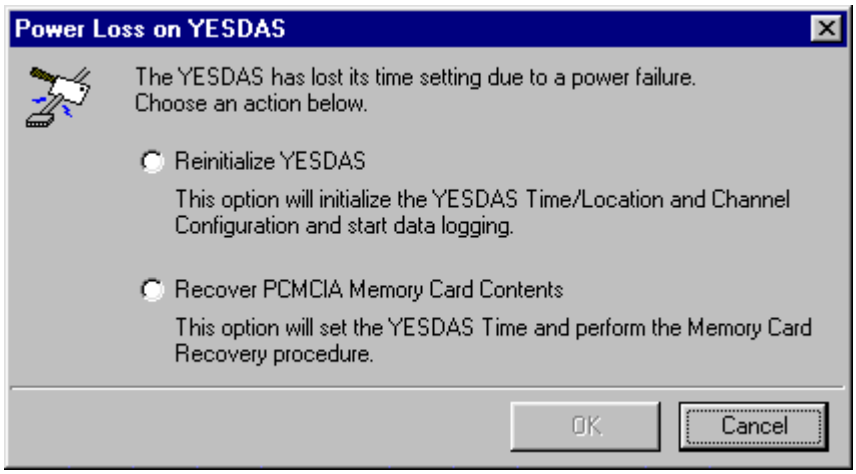
19 Select the Next button to display the final Wizard window.



Connecting to YESDAS

20 You will always want to verify that the communications hardware is wired up and working; YESDAS Manager runs a test for you automatically. Select the check box to connect to YESDAS when the Wizard is finished. If your communication port is configured properly and YESDAS is connected and powered on, when you click on finish YESDAS Manager will automatically start a new communication session and connect to YESDAS automatically, displaying the terminal window.

The first time you connect to YESDAS after applying power (or if YESDAS has experienced an AC power failure), YESDAS Manager detects that power has been lost by seeing that YESDAS is in a reset state and displays a window that prompts you for action:



You have one or both of the following options, depending on the value of the PCMCIA option in your YESDAS properties (which depends on whether you have the PCMCIA expanded memory card hardware option installed in the YESDAS at the site). Both options require that you log into YESDAS as supervisor. If you do not have supervisory privileges, you will not be able to continue.

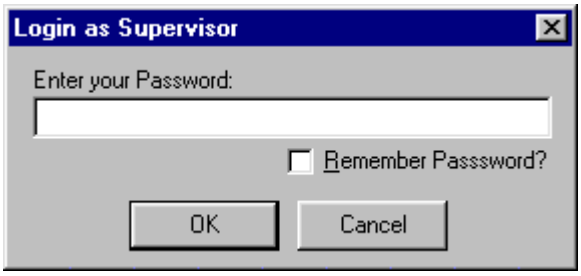
- **Reinitialize YESDAS.** This option walks you through the process of configuring your YESDAS. Once you have initialized YESDAS the way you want, you are prompted to start data logging.
- **Recover PCMCIA Memory Card Contents.** If you have a PCMCIA memory card option installed, any data on the card are preserved when YESDAS loses power. You must, however, perform the memory card recovery procedure in order for YESDAS to recognize that data after a power loss. This option performs the recovery procedure automatically. For more information on recovering memory card data, see your *YESDAS PCMCIA Memory Card Option Installation and User Guide*.

Initializing YESDAS

In this example, you will initialize YESDAS for the first time. Because it was just powered on, YESDAS-2 is in its reset state and contains no data.

1 Select the Reinitialize YESDAS option from the Power Loss on YESDAS window.

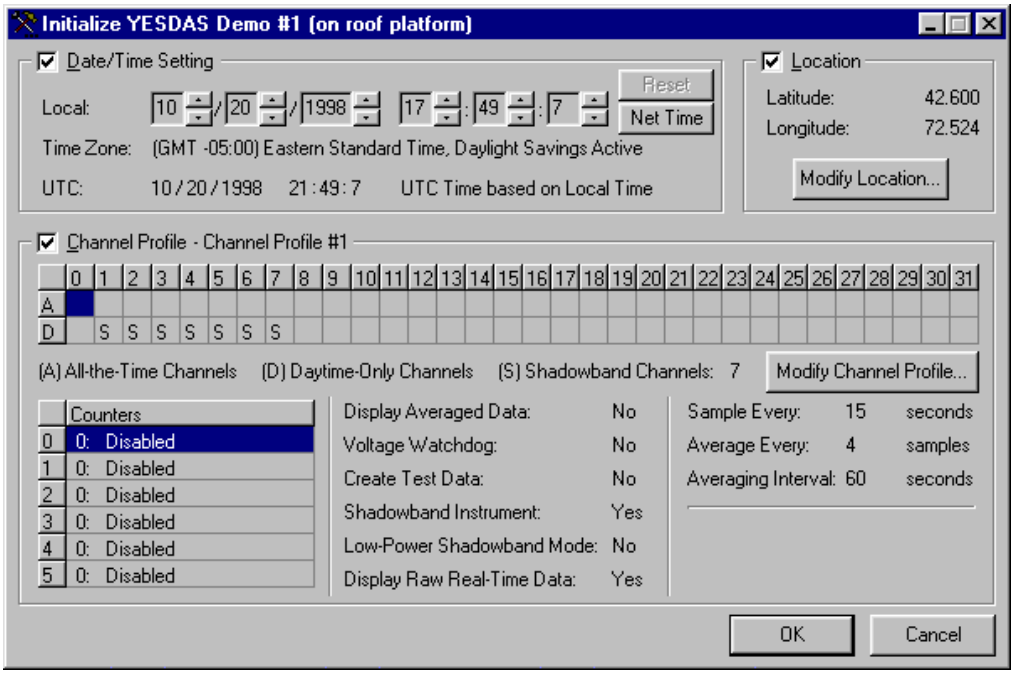
YESDAS Manager prompts you for your *supervisor* password. The password is included in your **.cal** file as a comment. You can open the **.cal** file using any text editor; and then search for the string *password*.



2 Select the Remember Password check box to save the supervisor password in your YESDAS Properties file. Be aware that anyone who runs YESDAS Manager to access this YESDAS can now log into YESDAS as supervisor without re-specifying the password. You can later clear the saved password via the YESDAS Properties window.

Important: In nearly all cases you should select *remember password* since the Automated Attendant requires it be stored because it needs access to the supervisory level to be able to clear the memory buffer. Unless you cannot control the physical access to the PC where YESDAS Manager is installed, check the box. (In this case you might be better off using a web browser on the uncontrolled PC and installing YESDAS Manager on a more secure machine.)

3 Select the OK button to continue with the initialization procedure.



Notice that the location and channel configuration information that was specified in the Setup wizard now appears in this window. You can modify the information at this point or specify additional system settings. Since you are setting up the system for checkout purposes, you need not set advanced options at this point. You must, however, ensure the time is accurate; otherwise your YESDAS-2 will not sample daytime or shadowband channels correctly and, for shadowband systems, the band will not shade the diffuser properly.

4 Ensure that the date and time displayed in the Date/Time Setting group box are accurate. The Date/Time Setting shows your local PC time and then calculates Greenwich Mean Time (or UTC) based on your Time Zone and Daylight Savings setting in your Windows Control Panel. If the displayed local time is not correct, you can override it on this window. Be aware that overriding the value on this window does *not* affect your PC clock — you must do this from your Windows Control Panel. As you adjust the time, YESDAS Manager adjusts GMT time to reflect your changes. The Date/Time Setting clock continues counting until you send the Initialization sequence to YESDAS.

If your PC is currently networked to the Internet via dialup (PPP) or a LAN (Ethernet) TCP/IP connection, the *Net time* button allows you to conveniently synchronize the time displayed in the Date/Time Setting box with a cesium atomic clock-based time server on the Internet. This is an

extremely convenient and desirable way to keep the time synchronized, especially to multiple sites. Note that this feature is only viable if you have an active TCP/IP connection to the Internet and firewalls are not blocking the ports required by the time server. By default, YESDAS Manager is configured for four time server path, maintained by U.S. Government agencies and available to users worldwide via the Internet, so you should not need to adjust these settings. For your convenience the NISTIME32 tools located on the CD-ROM lets you set your PC's clock to NIST's atomic clock, (others are available on the Internet, see http//www.time.nist.gov for more information on how to use these programs.)

If you have a live connection to the Internet, the *Net Time* feature fetches NIST time and updates the time displayed in YESDAS Manager. Note that this is only for YESDAS Manager; as it does not affect your PC's own clock. Due to the technology used in today's PC's, the clock in it is likely to be much less stable than the carefully designed software trimmed timekeeping system in your YESDAS hardware. Although the data records are time stamped internally by the YESDAS hardware, Since YESDAS Manager relies on your PC's clock to timestamp individual files it is also important that your PC have an accurate time setting. For example, if you're using a laptop to connect directly via RS-232 to initialize a YESDAS at a field site and you do not have another source for acquiring accurate, network-based UTC time, you should synchronize your laptop's clock before taking it out in the field.

5 Accept the default values for the other fields on the Initialization window.

6 Select Ok to continue. YESDAS Manager prompts you for confirmation:

Select one or more of the following options:

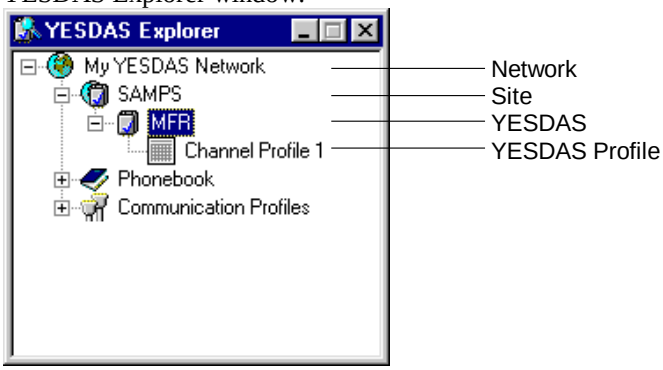
- **Initialize YESDAS.** This option sends the initialization sequence to YESDAS. Although it will clear the 32K memory buffer. The initialization sequence consists of the following commands: **U**pdate, **L**ocate, **N**umber, **I**nitialize, and **J** (Counter). These commands are described in detail in the YESDAS Installation and User Guide's *Command Reference* chapter.
- **Start Data Collection (will erase/overwrite data in memory card).** This option sends the G 1 command to YESDAS, instructing it to begin logging data. Be aware that any data in the 32K buffer or PCMCIA Memory Card Option are erased when you start data collection. You may want to wait until you have checked that the YESDAS status is normal before you start data logging.
- **View Status.** After you initialize YESDAS, you should check its status to ensure that is configured the way you want. See below for more information.

If you select none of the above options, YESDAS Manager still opens a communication session with YESDAS, but it does not send any commands to the datalogger. The terminal window displays the YESDAS command prompt, but you need not type commands. Once you have a terminal window open, you can use toolbar icons and context menu options to configure and communicate with YESDAS. If you are comfortable typing simple YESDAS commands directly into the terminal window, you can work this way.

However, be sure to use the YESDAS Manager menu/dialog user interface if you need to make any profile changes so that YESDAS Manager will create**.cal** and **.sol** files to match your new configuration.

Getting Familiar with YESDAS Explorer

Once you have created a new network and site you should be presented with the YESDAS Explorer window:



MS-Explorer-like YESDAS Explorer window

The YESDAS Explorer was designed to be as similar to your MS-Windows Explorer as possible. If you are not comfortable with Explorer or would like more details on using and navigating and using it, consult your MS-Windows user documentation.

Adding Another YESDAS to the Network

You can add additional YESDAS sites or new sensor hardware to your network configuration by creating a new YESDAS *profile*. Because YESDAS Manager is built with object-oriented technology, many of the same functions you used to create the initial network are used to add other objects or functionality to the existing tree. The general rule is to select the parent object and use the secondary mouse button to add a child object; for example, use the secondary mouse button ("right click" on a right-handed mouse), on the network object to add a new site to the network. Do the same on a YESDAS to add a new profile to it. In each case the same familiar setup wizard guides you through a series of questions that builds the new object.

YESDAS Communication Test

Each time you make changes, it is important that you test the configuration manually -- due to the many possible configuration choices and potential for hardware communications problems, don't just assume that the system will work exactly as you wanted. Conduct an "end-to-end" data recovery test to verify the configuration settings are all correct.

Basic Serial Communications Test

In this section, you test that YESDAS Manager is able to successfully communicate with the remote YESDAS data acquisition and control system hardware. You will first connect with the YESDAS, initialize it using the settings currently stored in your ChannelProfile1; next, after waiting about 5 minutes you will download the data (stored using the default storage interval of 60 seconds) and then you should be able to view the data.

1 Select the YESDAS in your YESDAS Explorer.

2 Select Action, Connect. Since this is likely the first time you are initializing the remote YESDAS after applying power, YESDAS Manager may inform

you that the YESDAS had previously lost power, otherwise you may skip the next step.

3 Select Reinitialize YESDAS and OK

4 Login as Supervisor. The case-sensitive supervisor password is always “Irradiance!”

5 Note: Ensure that you check the *Remember Password* option since it is required for proper operation of the YESDAS Attendant.

6 In the Initialize dialog box, ensure that the Local time is correct, adjust it either manually or by using the "Net Time" button. If your workstation is connected to the Internet the Net Time button retrieves the current date and time using the RFC868 TCP Time Protocol to connect to the National Institute of Standards and Technology's atomic clock.

7 Proceed with initializing the YESDAS-2 by selecting OK.

8 Once initialized, if a MFR-7 is configured you should see the MFR's Shadowband move and block the direct normal of the sun on the second stop. If the instrument is not adjacent to the workstation it is a good idea to have someone at the remote site verify that the shading takes place properly. Data should appear in the Raw Real Time Graph and Raw Real Time Data tabs of the Terminal window after each sample period. Note that at least 128 bytes must be in the YESDAS data acquisition and control system's buffer before calibrated real time data display can begin. You may need to wait about 5 minutes to collect more than 128 bytes in the data buffer depending on the acquisition rate.

9 Next, turn off the Raw Real Time mode by selecting the Terminal tab and press the right mouse button within the terminal window and then the *Raw Real-Time Data* menu option.

10 Download the current data. Press the right mouse button in the Terminal tab and choose *Receive Data*. The download should then proceed and you should be presented with a Data Manager window containing the currently downloaded data.

11 In the Data Manager window, choose the *Apply Solar Angle Correction* button and proceed with viewing the contents of the remaining tabs in the Data Manager. Each tab starts another step of the data processing (angular correction, Langley processing, then calibration of the data). In particular, verify that each tab processes the data without encountering any errors. YESDAS Attendant will process data following these same steps. If you encounter errors this likely indicates that you did not synchronize your YESDAS hardware initialization/configuration with your current profile setup - consult the later sections in this documentation to rectify the configuration problem before proceeding.

Note: Once you install the YESDAS Web Server component, a simple way to check data is to open a live connection to a YESDAS and then point a web browser at the YESDAS Web Server. Assuming that the YESDAS-2 data collection rate is set to at least once every two minutes, in a few minutes new data should appear (be sure to select the "update" checkbox on your browser view). It is always a good idea to periodically review the communication logs to look for errors.

If the above steps are successful, you can then proceed with setting up the YESDAS Attendant and YESDAS Web Server. But first you need to plan how you will partition the system and plan for long term data storage and backup.

Component Structure and Functionality

Typically, all YESDAS Manager software components are installed on the same workstation. However, the YESDAS Web Server and Auto Attendant executables are also designed to run on separate PC hosts if optimal performance or capacity is desired, e.g. to support large networks of YESDAS systems. For example, in networks where many systems are polled over pools of modems a communications server can be dedicated to the Auto-Attendant.

To partition these functions what is required is that all the various PC workstations share the file system via some type of network such as or Microsoft's NT-Server, Novell's NetWare, Sun's PC-NFS or Samba. The login file access of the PC workstation must be set to at least read/write/erase/create or higher. Keep in mind that if the network server is shut down that the workstation connection will be lost and collection of data will stop until a human intervenes to login the PC to the server again. For this reason you should install Uninterruptible Power Supply systems on all servers and PC workstations. It is also advisable that these servers are rebooted as infrequently as necessary to maximize disk and data availability, especially during scheduled Automated Attendant data retrieval operations. Consult your local network administrator for help in setting up a multi-host configuration.

Backing up Your YESDAS Data

It is critical to understand that YESDAS-2 has a finite amount of storage and that long term data storage takes place on your PC or network server drive. To prevent data loss if a disk drive fails, you must provide a mechanism to automatically backup data that YESDAS Manager writes to your local or network-mapped server drive. Most LANs within larger organizations have centrally administered, often with carefully designed backup systems and policies in place to backup user PC workstations. Contact your local site administrator or MIS/IT department to determine if your local disk drive is backed up. If not, you should periodically copy data to a network drive that is backed up regularly.

Important: After the YESDAS Manager Automated Attendant retrieves data from a remote YESDAS-2 the **.xmd** data files are merged to create new midnight-to-midnight **.mtm** non-overlapping binary files. If you check the appropriate box in the Attendant' Job setup, older **.xmd** files are periodically deleted to save disk space, since the .**mtm** files contain the same data. *In this case you should retain all backups of your data drive on a daily basis.*

Archiving Data Files

While backup is essential, as time goes by and more and more data will be collected and disk drives will fill up. As you acquire more and more data from your YESDAS-2 system(s) you may find it necessary to move older data to tape archives for off-line storage. To analyze this off-line data you will need to restore from tape to the original data directories. Contact your local system administrator or MIS/IT department for help in creating a backup/archiving data strategy or for copying data files to tape. The data file directory structure YESDAS Manager uses is exactly as it appears in YESDAS Explorer's view of the data tree. Each YESDAS Network directory contains:

- Site directories containing one or more YESDAS-2 systems as directories below it;
- YESDAS-2 system directories below each site containing one or more profile directories below each;
- Profile directories containing all stored binary and output data and calibration files for each profile setup.

Setting Up and Configuring the Automated Attendant

The YESDAS Automated Attendant is a major time-saver when operating even a small network of YESDAS-2 systems. Although you can always retrieve YESDAS data files manually via the terminal window, (for example to test a new communications device) it is essential that you configure the YESDAS Attendant to retrieve it for you on a routine basis, typically daily. The YESDAS Attendant performs other supervisory functions such as error detection and notification that are essential to the proper operation of any data collection operation. It can also make calls to remote systems at a time of day when the rates are lowest, saving you money on your telecommunication costs.

The YESDAS Attendant automatically downloads data from the YESDAS Data Acquisition hardware and generates Day files on a scheduled basis. The Attendant also has the capability alerts users of site problems such as hardware error conditions via email on a network-wide or site-specific basis. For example, for multiple site networks, the Attendant logs can be mailed to a site-specific email account such that field technicians can be dispatched to rectify hardware problems at remote sites. This is a powerful feature that can help to automate maintenance tasks and keep your network running smoothly.

YESDAS Manager is a SMTP and MAPI-compliant (Microsoft's Mail Application Programming Interface), so you can email via Microsoft's Outlook and Exchange and other popular mail packages, as long as you have email installed and running on the PC where the YESDAS Manager Attendant is running. If you do not have a SMTP or MAPI-compliant email tool configured for your PC, refer to your local system administrator for help. Otherwise, skip the following two steps.

First, define the email addresses for the site and network objects in the YESDAS Explorer.

1 The central email setting applies to the entire network, so Select the Network object (the top level object in the YESDAS Explorer) and with the 2nd mouse button select Properties.

2 In the Contact Information tab specify the email address of the network operator and press the *Test Mail…* button to confirm the YESDAS Manager's ability to send email. Assuming that your PC is already setup to send email, verify that the mail made it to the proper mailbox.

Next, perform the previous steps for each Site. Note that if you wish to have a Site-specific email address for the Attendant (for example for local site operators near each remote site), you can specify an email address for each site.

Now define the Attendant "job" for a site and test its execution.

1 Select the YESDAS object in the YESDAS Explorer and choose Properties (right mouse button or toolbar properties button).

2 In the *Attendant Jobs* tab, press the right mouse button and choose New…

3 Enter a job name—in this example it is 'FetchSite1'

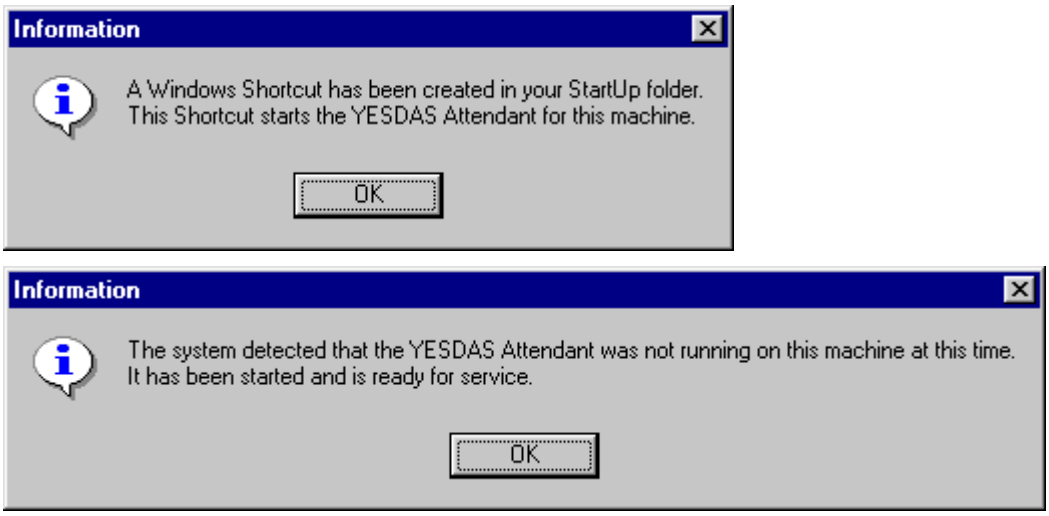
4 Go to the *Schedule* tab and setup a Next Run Date and Time. Verify that the "enable job" box is checked. Click on the "My Computer" button so that the Attendant runs on this PC.

5 In the *Job Options* tab check these buttons:

- "Auto Restart on Power Loss"
- "Erase PCMCIA memory card buffer after successful download"
- "Merge downloaded data with day files"

6 If you have either an SMTP or MAPI-compliant email tool running on your PC select "Email Log to Site/Network Contact"

7 Choose OK when done. You will see the following dialog messages:



At this point the attendant job will be installed and running. You should observe the YESDAS Attendant execution log either in your email inbox or in the YESDAS Attendant's job log.
The YESDAS Attendant runs as a MS-Windows 9x/NT "System Tray" application. The system tray is located in the lower right hand corner of your screen and the YESDAS Attendant appears as a check mark icon. Press the right mouse button on the Attendant's icon on the to view the menu; it lets you view the Attendant Log, Schedule or even start the YESDAS Manager application.

Setting Up and Configuring the Web Server

The purpose of the *YESDAS Web Server* component is to publish the collected data on the World Wide Web for other users to view via Netscape/AOL Navigator/Communicator 4.04 (or later) or Microsoft Internet Explorer 4 (or later) web browsers. Each YESDAS Manager installation includes a web server providing the interface to remote users via web browsers. You will want to install this component if you have a live connection from the PC to the Internet.
If this is part of a YSOS system (see later chapter on YSOS) the YESDAS Web Server also supports communication to the YSOS Console Manager, so even if you do not wish to publish data to the web you will need to install this component for the YSOS Console Manager.
Begin by defining a YESDAS Web Server for this YESDAS Network using the YESDAS Manager.

1 Select the Network object (top level object in the YESDAS Explorer) and choose Properties (right mouse button or toolbar properties button).

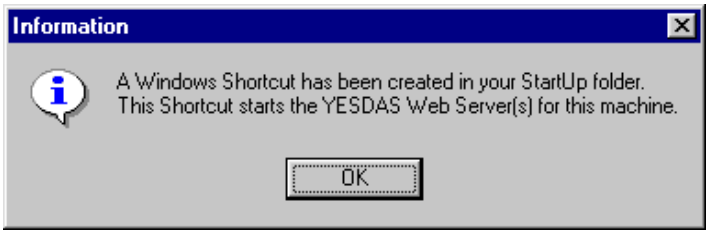
2 In the Web Servers tab, press the right mouse button and choose New…

3 Enter a web server name such as 'YESDASWeb1'. The Web Server name can also be the name of your host but is not directly related. You can have multiple web servers running on the same host as long as they are running on different TCP Ports (see step 4).

4 The default TCP Port for a web server is port 80. If you have already have port 80 in use due to some other web server that is running on your host you will need to specify a different port.

Note: If your organization's Internet connection is protected by a firewall, many are configured to permit only port 80 access. Thus it is wise to leave this setting at 80 unless there is a compelling reason to change it or there is a port conflict. However, it is possible to optionally configure the web server to bind itself to designated IP address on that host. This is useful if you have a multi-homed host with multiple IP addresses and don't want the web server published on all addresses. Leave blank to bind it to all IP addresses on that host.

1 Choose OK when done. You will see the following messages



2 Close the Network properties dialog box.

3 Select the ChannelProfile1 object in the YESDAS Explorer and choose Properties (right mouse button or toolbar properties button).

4 In the Web Publishing tab, check the YESDASWeb1 entry. This enables this YESDAS profile's Day files to be published on your YESDAS Web Server.

5 After enabling the web publishing of this YESDAS Profile choose OK.

6 Activate the YESDAS Web Server window and choose Options, Refresh. This refreshes the published profiles in the Web Server. The Web Server will automatically refresh the data every 10 minutes.

7 Using your web browser type http://localhost as the URL and you should be able to see the "YESDAS Web Access" page. If your organization is using an Internet proxy service, try entering http://127.0.0.1 and it should appear.

8 Note: depending on the YESDAS profile settings regarding data acquisition rates, you may have to wait a few minutes for the web server to publish the first YESDAS data. If you cannot see this page, carefully review the steps in this section and try repeating them from the beginning.

Advanced YESDAS Web Server Configuration

You can configure the web server to use standard (80) or non-standard TCP/IP ports. This way you can have an internal Intranet YESDAS Web Server on one port for local distribution and a second external Internet server on port 80 so that users can access it through firewalls. For example, here at YES, engineers can access our system on our Intranet network at:

http://yesdasweb1:8080.

Whereas outside customers can visit via:

http://sunlight.yesinc.com:80

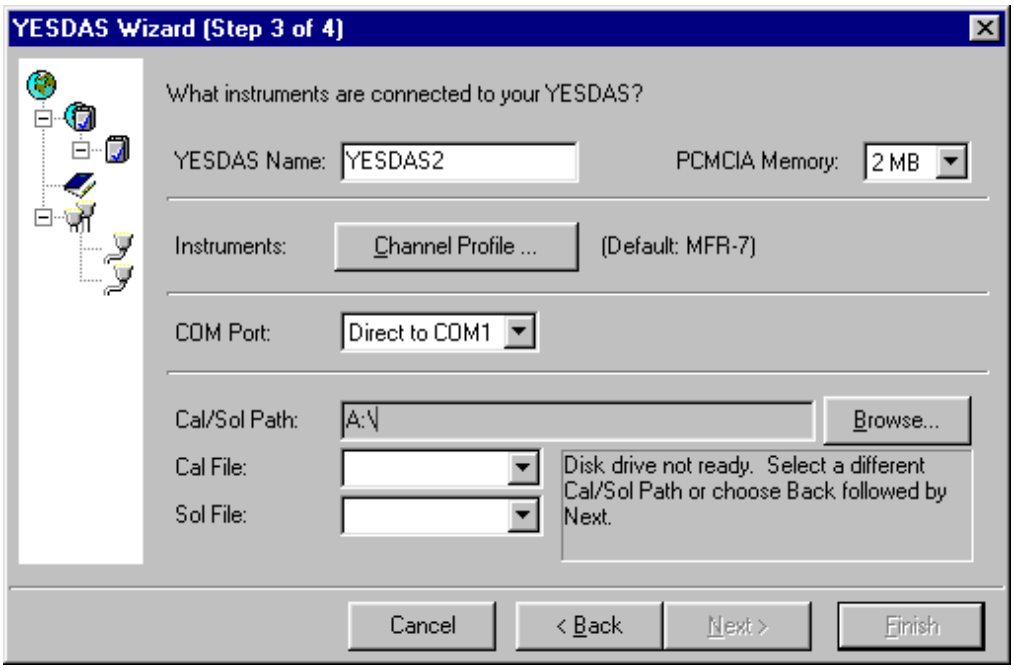
However, if you ever intend to use MS-Excel to interpret data, when attempting to open a MS-Excel spreadsheet over the web, Microsoft defaults the port number to be 80. Therefore, keeping the YESDAS Web Server at 80 supports this limitation. Also, users who access the Internet may have firewalls in between connections that typically are configured to refuse other than port 80. By the way, port 80 is a TCP/IP port that most web servers publish on, and is port number that everyone in general agrees with.

Data File Upgrade Strategy

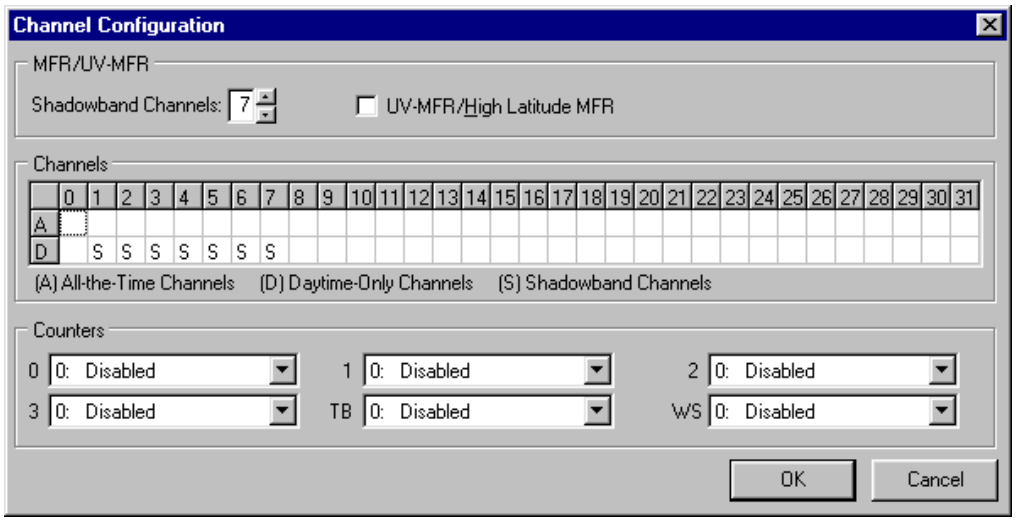
Note: If this is the first time you are using YESDAS Manager with a new hardware system and have no previous data files from earlier generation DOSBand tools you can skip this section.
If you are upgrading from an earlier MS-Windows version of YESDAS Manager, install the program in the same directory that the previous install used. YESDAS Manager is fully backwards compatible across all versions and there is nothing else you need to do. However, if you previously used YESDAS-2's DOS tools such as YESTalk and DOSBand and have many **.xmd** binary data files in various data directories, and you will import this data into YESDAS Manager in this section. Before you begin you will want to review how data files are stored within YESDAS Manager and do some planning. Once complete you can import these files into YESDAS Manager using the following steps:

1. First, carefully verify that you have a valid pair of **.cal / .sol** files for all your YESDAS-2 binary data files, and check that there is only one calibration epoch that spans each batch of binary data files. If not, you need to create a new YESDAS Manager profile to match each and every valid **.cal / .sol** file pair. You must sort these into separate directories where each one contains the valid **.cal / .sol** pair and binary data files they belong with. It is a good idea to use the DOS tools to process all binary files to be sure that they belong to the appropriate set of **.cal / .sol** files.

2. Under the Network, create a new site that will hold the YESDAS-2 data (use the second mouse button on the Network Object).



3 Under the Site create a new YESDAS (use the second mouse button on the Site Object). From the dialog shown above use the Browse… button to point to the directory that contains the **.cal / .sol** files that match your data.



Match the profile for the new YESDAS Object to the YESDAS-2 settings you previously used to collect the data with.

4 Create a new profile (use the second mouse button and click on the YESDAS object and select "New YESDAS Profile").

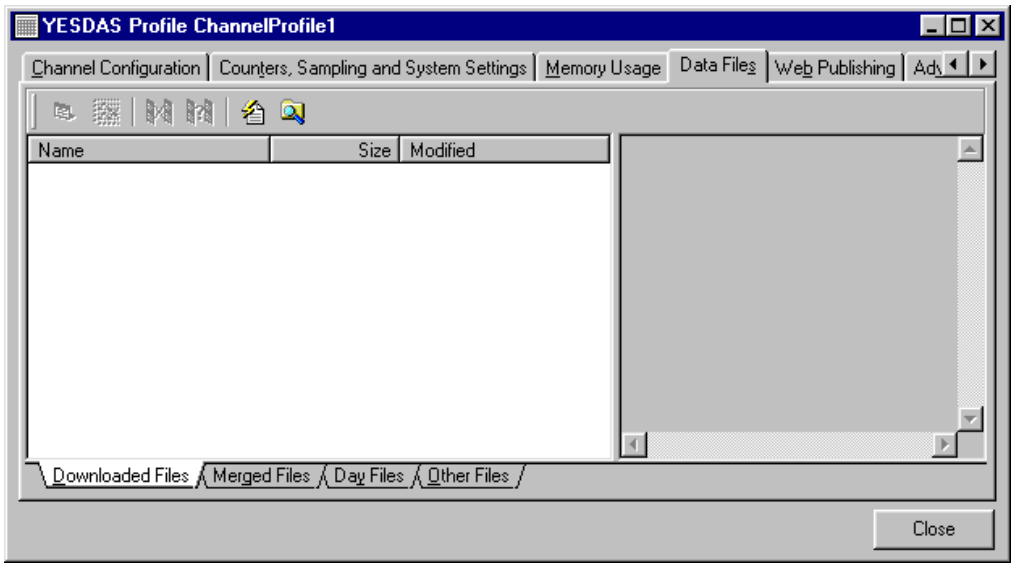
5 Click on the "Channel Profile…" button in the dialog box. When the dialog box above appears, carefully match the profile settings to the ones originally used to create the data.

Important: It is essential to get the settings correct or you will have to repeat the entire import process. If you cannot recall the settings, use DOSBand to unpack the data file, where the settings will be indicated.

6 Tell the wizard to connect to the wizard when it finishes creating the new object. Verify, via the Status icon on the toolbar, that the system serial numbers match the ones in your .cal / .sol files.

Note: If you cannot connect to YESDAS at this point stop and determine what the communications problem is before proceeding.

7 Once the new YESDAS in created by the wizard, double click on the profile to open the data file window



Data Files profile view. The icon to launch MS-Explorer is the magnifying glass at the rightmost position on the toolbar.

8 The Downloaded files area will appear empty. Click on the MS-Explorer icon on the toolbar and browse to the location of your old data files. Select the files using the mouse and copy them to the MS-Windows clicpbaord (Ctrl-C).

9 Move the mouse back to the Downloaded files area and using the second mouse button on the empty window area immediately above the tab, select Windows Explorer.

10 In this new second instance of MS-Explorer, select Edit > Paste from its menu. Your data files will be pasted into the correct YESDAS Manager data directory.

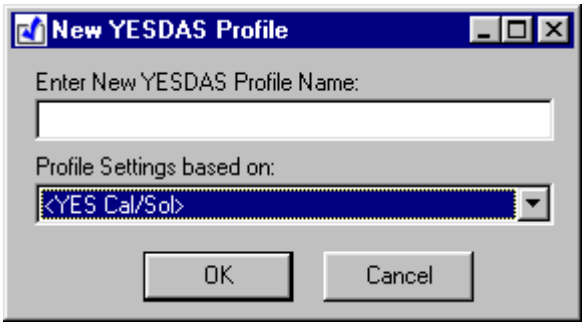
11 Click on the Data Files tab again to make YESDAS Manager the active window and press F5 to refresh the Data Files window, (the newly imported data files should appear)

12 Within the Downloaded files section select all of the data files with the mouse button. Now using button 2 select "Merge/Split with Day Files." This creates new midnight to midnight data files.

13 Test viewing the day file data by double-clicking on each day file and then applying angular correction by selecting the check box at the top of the Data manager window.

Caution: If you encounter an error message indicating you have the incorrect **.sol** file for the data, your Solar Information file (**.sol**) does not match the data and you must stop and fix the problem by manually editing the file. Note that you should edit this file with extreme care, and verify that the problem exists across all data files in the set you imported. Check that DOSBand encounters the same problem.

14 Next, if you have more than one set of valid **.cal / .sol** files, you will need to create new profiles for each set that site (use the second mouse button on the site name and select "New YESDAS Profile…").



The second and subsequent profiles can be based on the first one you created as shown above.

Important: All of the files belonging to each YESDAS-2 object *must* have the same set of system and head serial numbers - if the head was ever disconnected at power up, the data file will show 0000 as the head serial number.

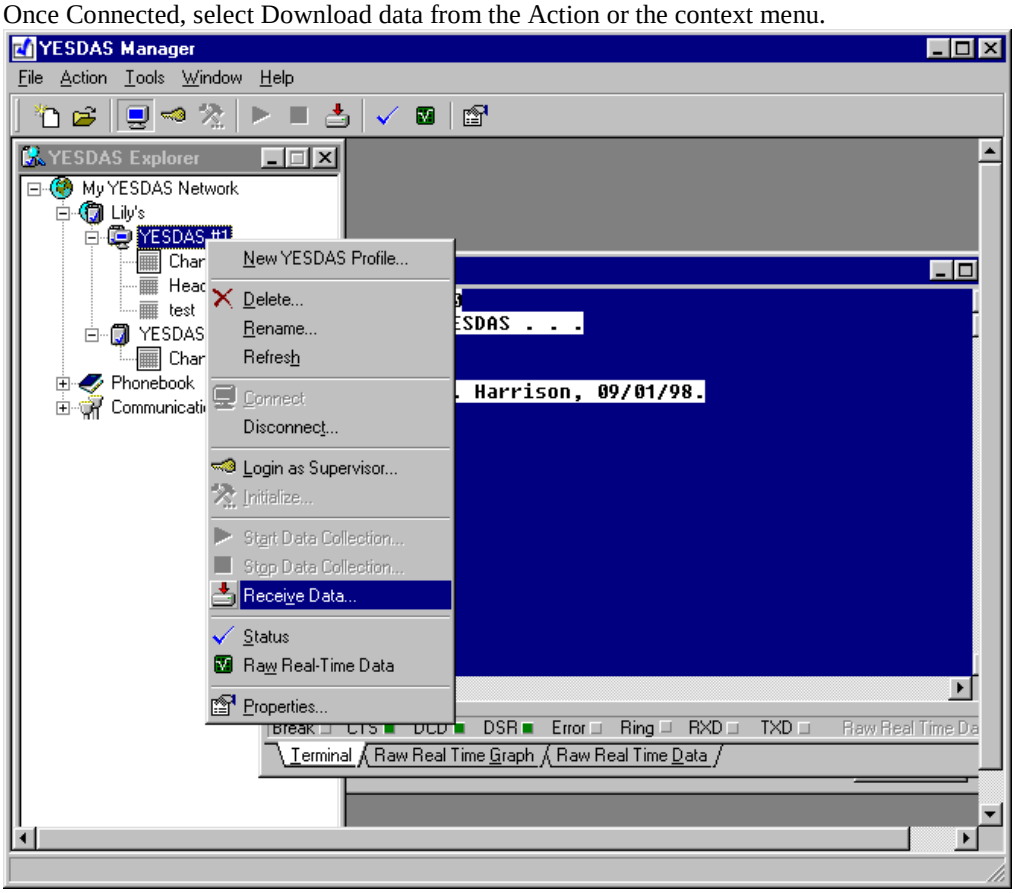
Watch for any error messages that indicate that the **.cal** and **.sol** files do not belong to the binary data you read in. In this case you must edit the files manually to fix the problem, and follow this procedure to create separate YESDAS objects for each set of files that do not match.

Working with YESDAS Manager

This chapter covers basic operations by doing routine tasks such as manually collecting, processing and displaying YESDAS Manager data. Note that the Automated Attendant normally performs these steps for you.

Manually Retrieving Data From a Remote YESDAS

Select the YESDAS system you wish to download from using the YESDAS Explorer, and using mouse button 2 to activate the context menu, select Connect.
Once Connected, select Download data from the Action or the context menu.

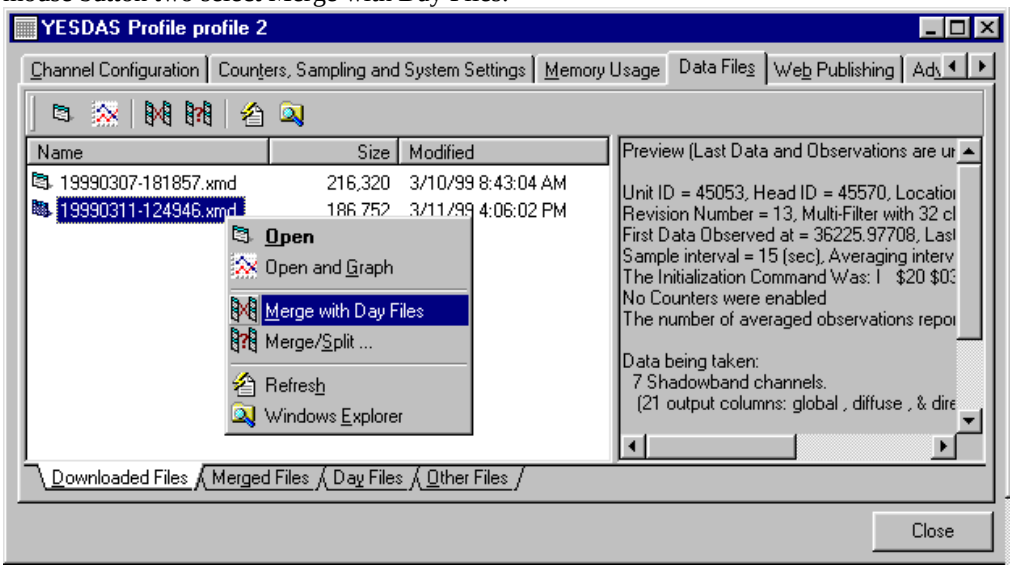


YESDAS connection is established, just about to perform manual data receive.

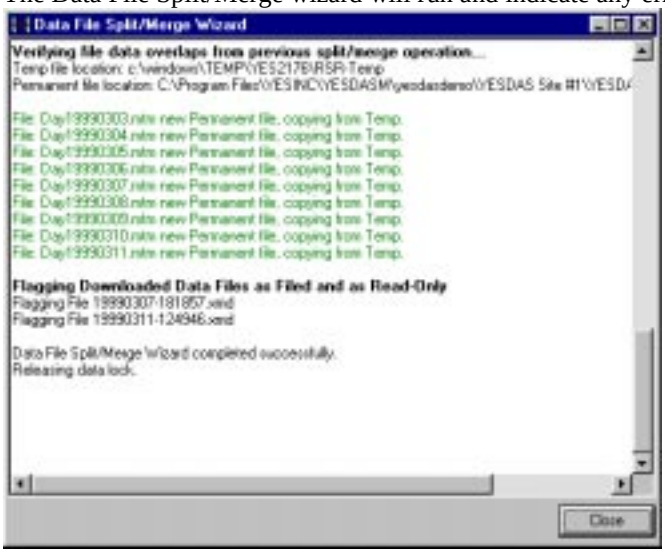
Note: If you do not see the terminal window successfully connect, you have a serial port configuration problem. Review the previous chapter and run a serial communications test to the YESDAS-2 hardware.
YESDAS Manager will place the data in the "Downloaded files" in the Data Files view of the profile object associated with the YESDAS system.

Processing the Data

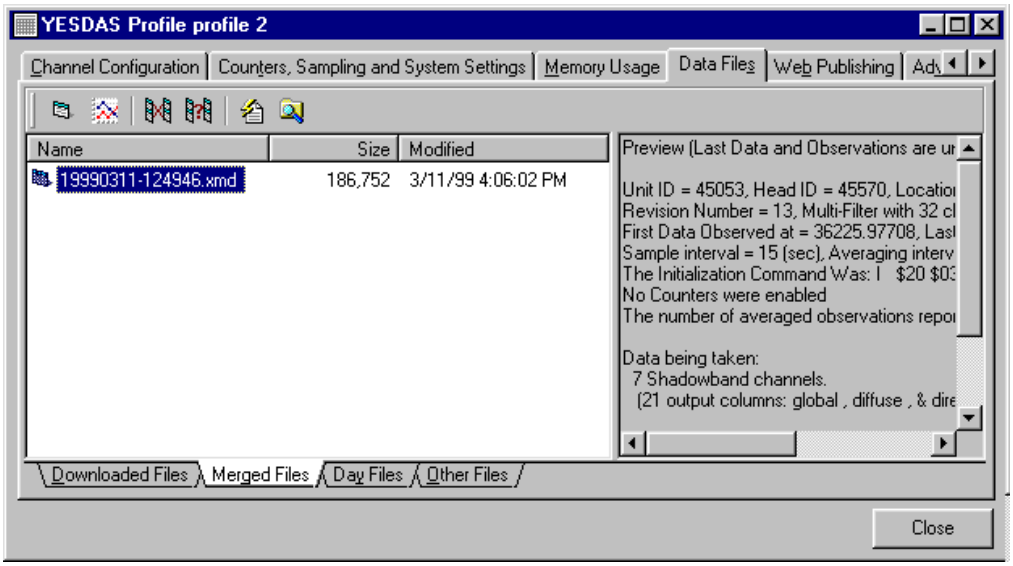
Once you have retrieved a YESDAS binary data file you can merge it and create a day data file. Select the profile and look at the Data files tab. Highlight the new file and using mouse button two select Merge with Day Files.



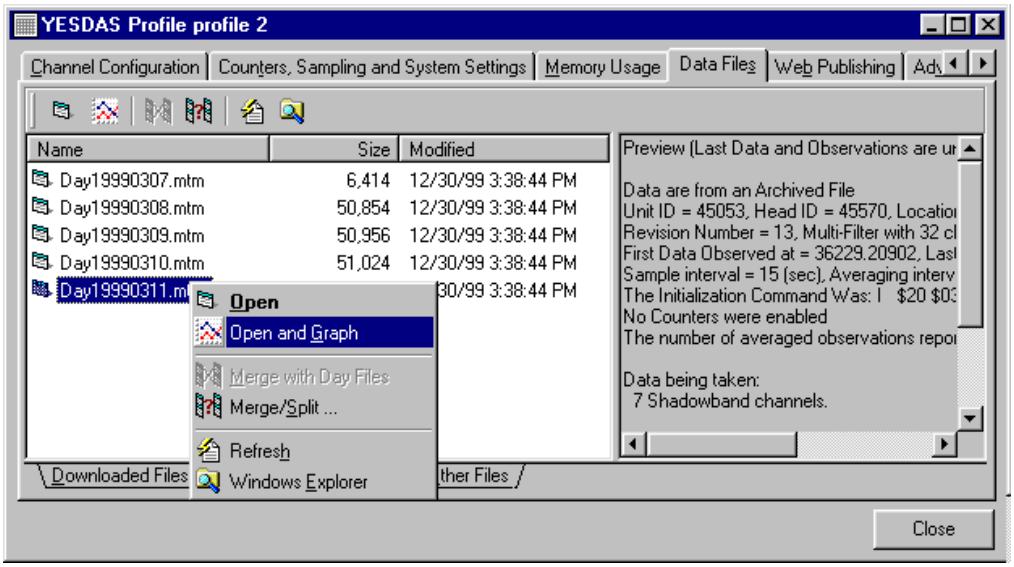
About to merge collected binary file.
The Data File Split/Merge wizard will run and indicate any errors it encounters.



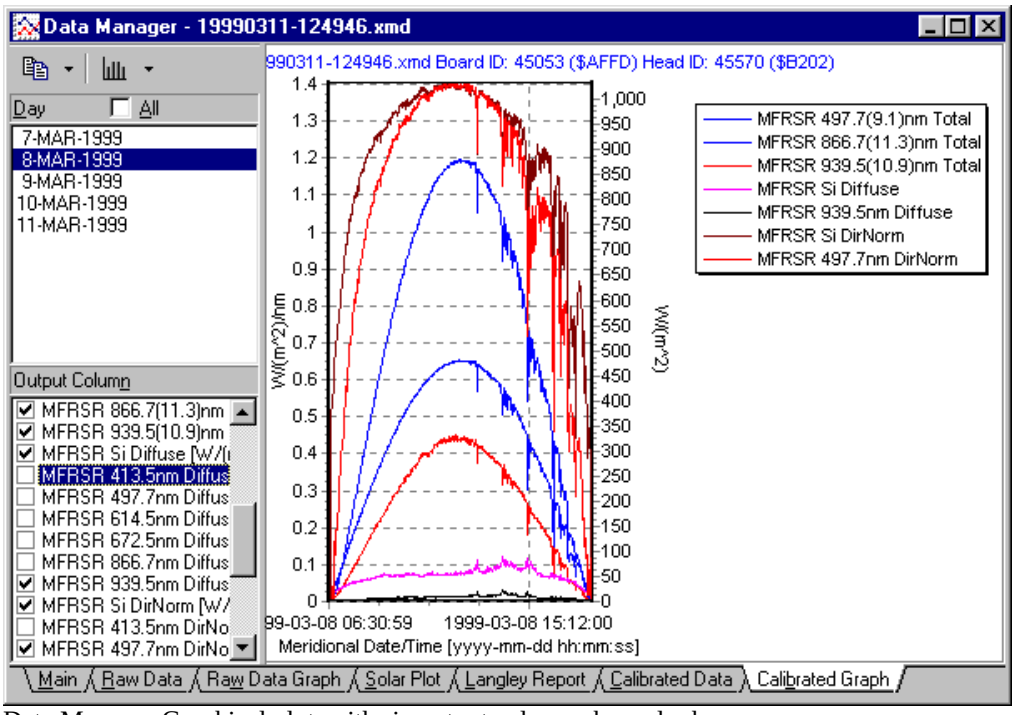
When it is finished it will place the file in the Merged Files tab, and a new Day File will exist for it. It will no longer appear under the Downloaded Files tab.



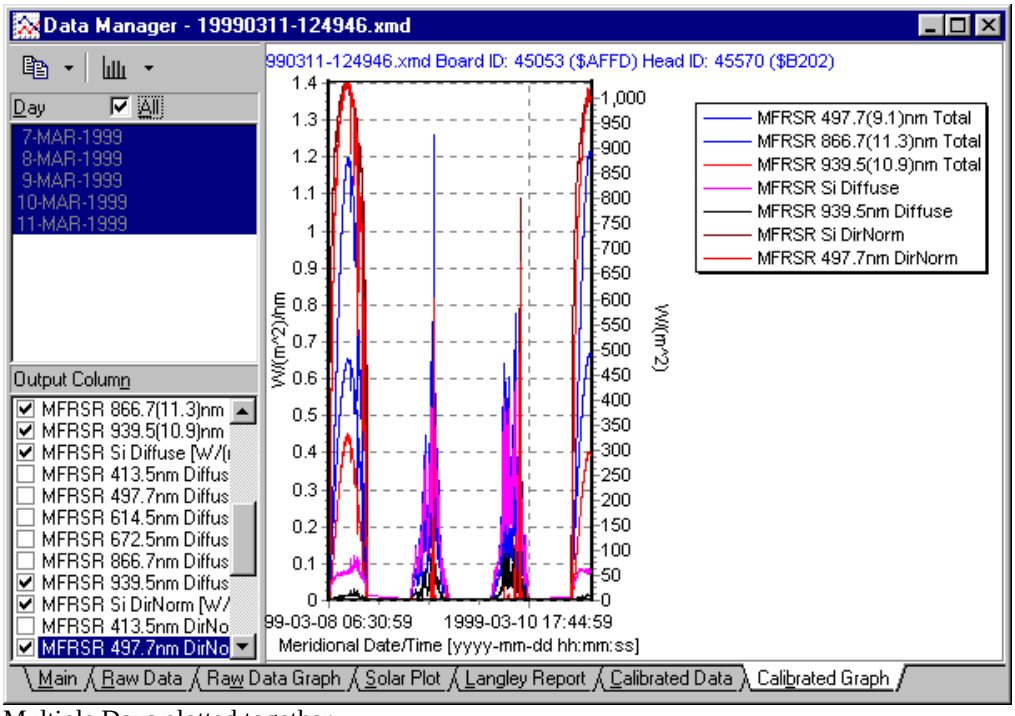
The Downloaded file is now merged and no longer appears under Downloaded Files tab. Now that a day file has been created, you can look at the data. Move to the Day File tab view and using mouse button two, click on the Day file you wish to graph. Note that you can have do this automatically from the Downloaded Files— tab, but for illustration purposes



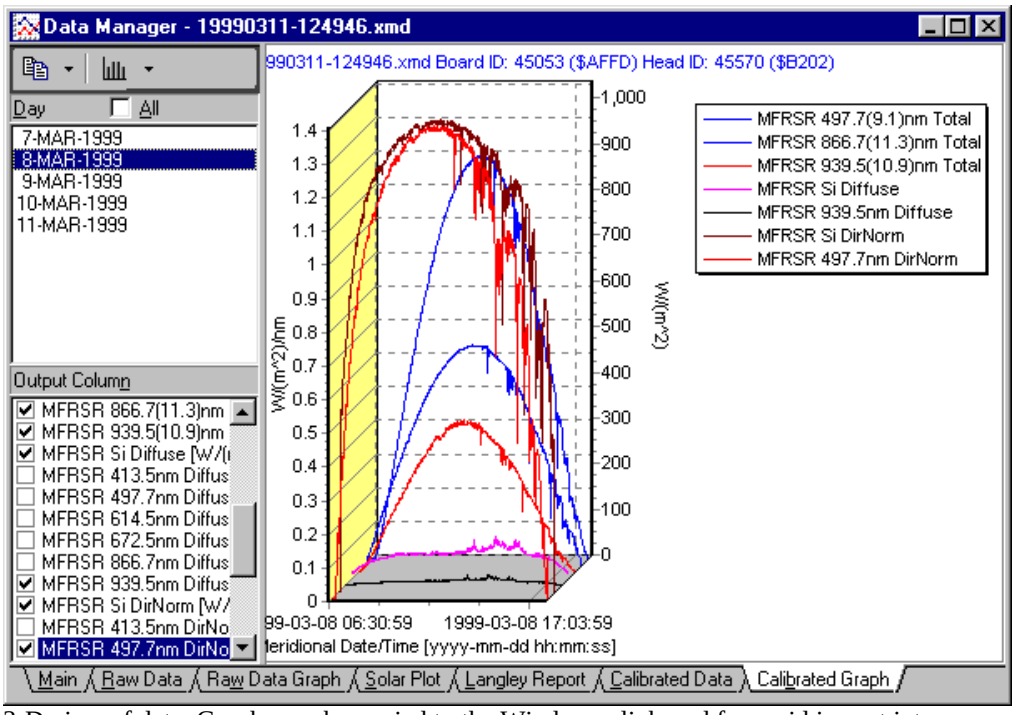
New Day file, about to be opened and graphed by the Data Manager.
Note: The Data Files tab is a special filtered view of the system's profile directory - all files are actually located in the same data directory.



Data Manager Graphical plot, with six output column channels shown.
In the Data Manager, the columns that get plotted are controlled by selection check boxes in the lower left window area. The days available for plotting appear within the data file appear in the upper left area of the window. You can highlight one or more days as shown below.

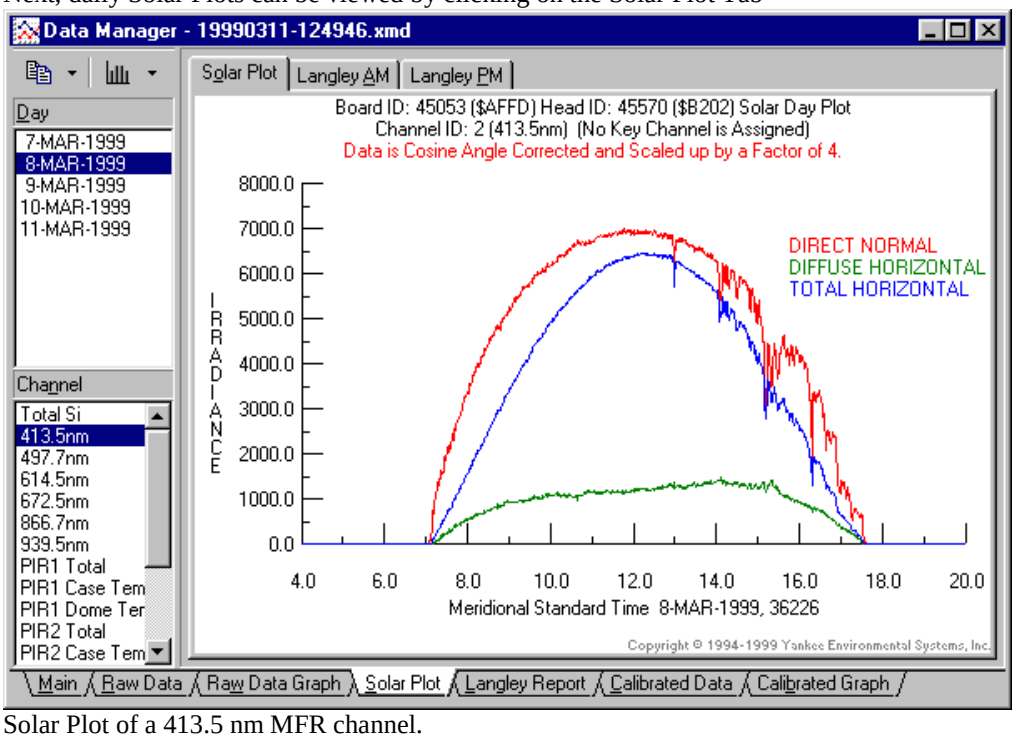


Multiple Days plotted together.
You can also control whether the plot is 2-D or 3-D via the icon at the upper left corner of the window.



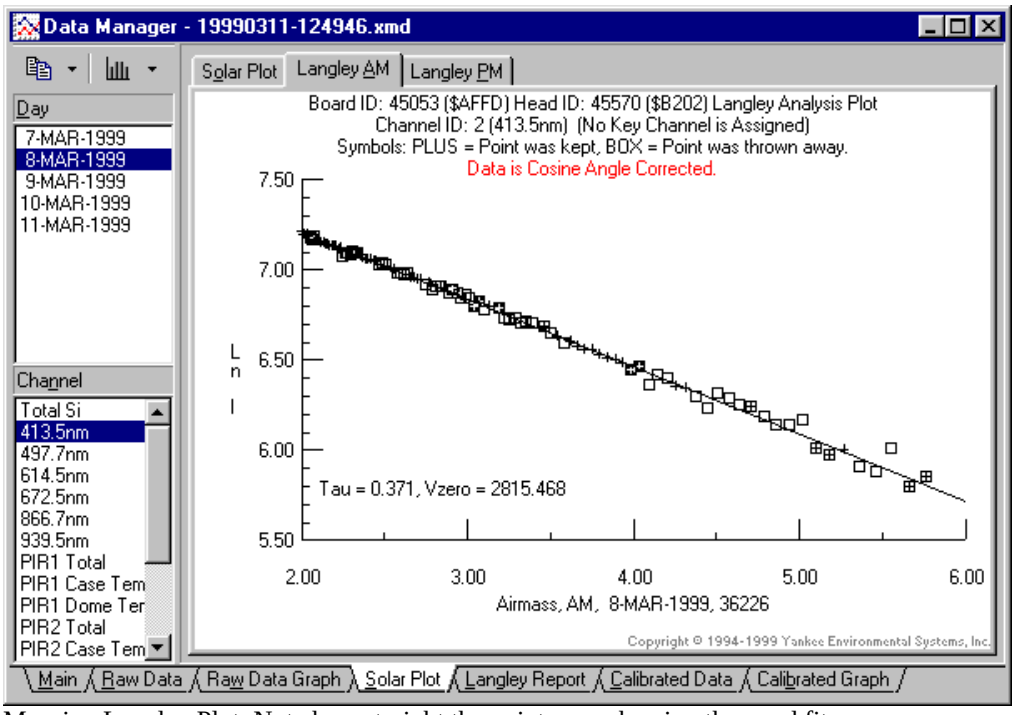
3-D view of data. Graphs can be copied to the Windows clipboard for rapid import into your favorite MS-Windows Applications.

Next, daily Solar Plots can be viewed by clicking on the Solar Plot Tab

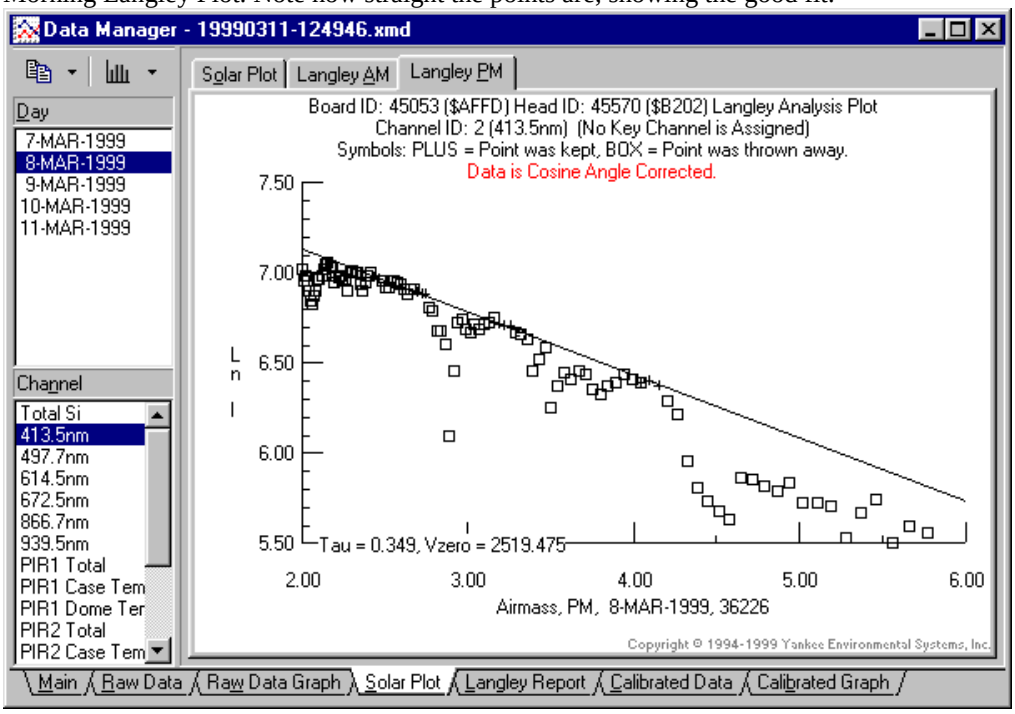


Solar Plot of a 413.5 nm MFR channel.

Note the morning is clear while there was some cloud activity in the afternoon. Click on the Langley AM and Langley PM tabs at the top of the graph to view the results of a Langley plot.



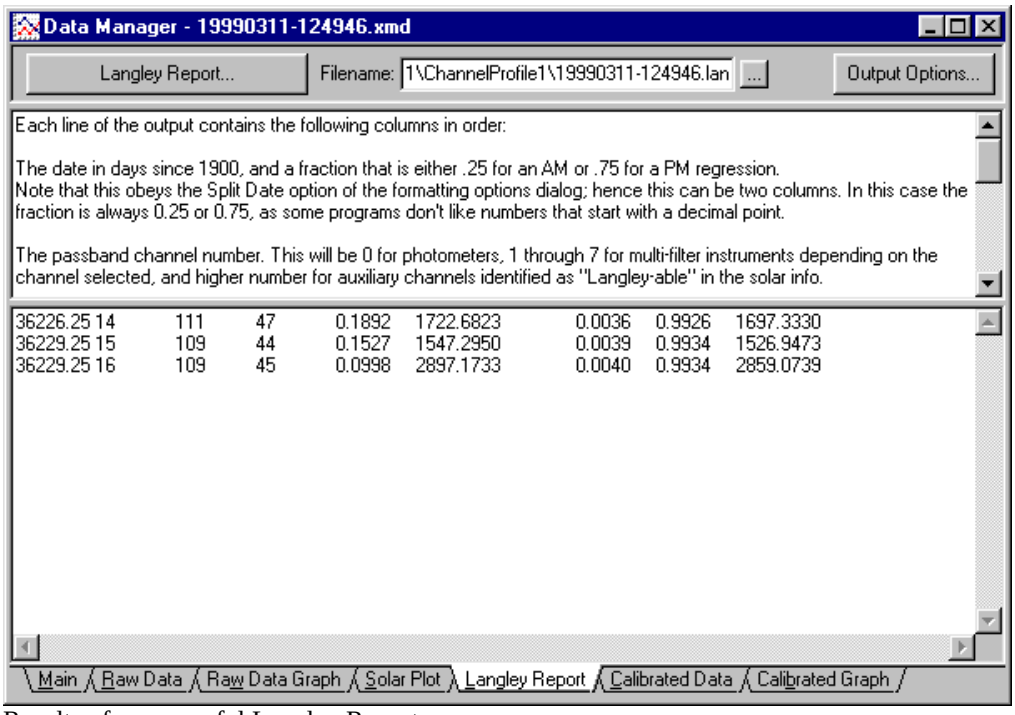
Morning Langley Plot. Note how straight the points are, showing the good fit.



Afternoon Langley Plot. Note how minor cloud activity impacts the line fit.
The Langley airmass range is adjustable from this screen as well to suit your needs.

Running a Langley Report

The Langley report differs from the Langley plot available under the Solar Plots tab, in that it is run through the Harrison Objective algorithm to throw out bad data. Using the tab interface to browse Solar Plot data and locate a channel from a clear day to analyze. Assuming the channel is valid to be run through Langley processing (which is enforced and controlled by statements the Solar Information file), click on the Langley Report tab and select the "Langley Report…" button. The following window will appear when it completes the processing:



Results of a successful Langley Report.
You can adjust file output options from this window. Data are written to ASCII files in the current profile directory, and these output files end in "**.lan.**"

Importing Data From the Web Server

One of the more powerful features of YESDAS Manager is the ease by which you can import data into MS-Excel. Simply

1 Locate the data you want to import by browsing the YESDAS Web Server.

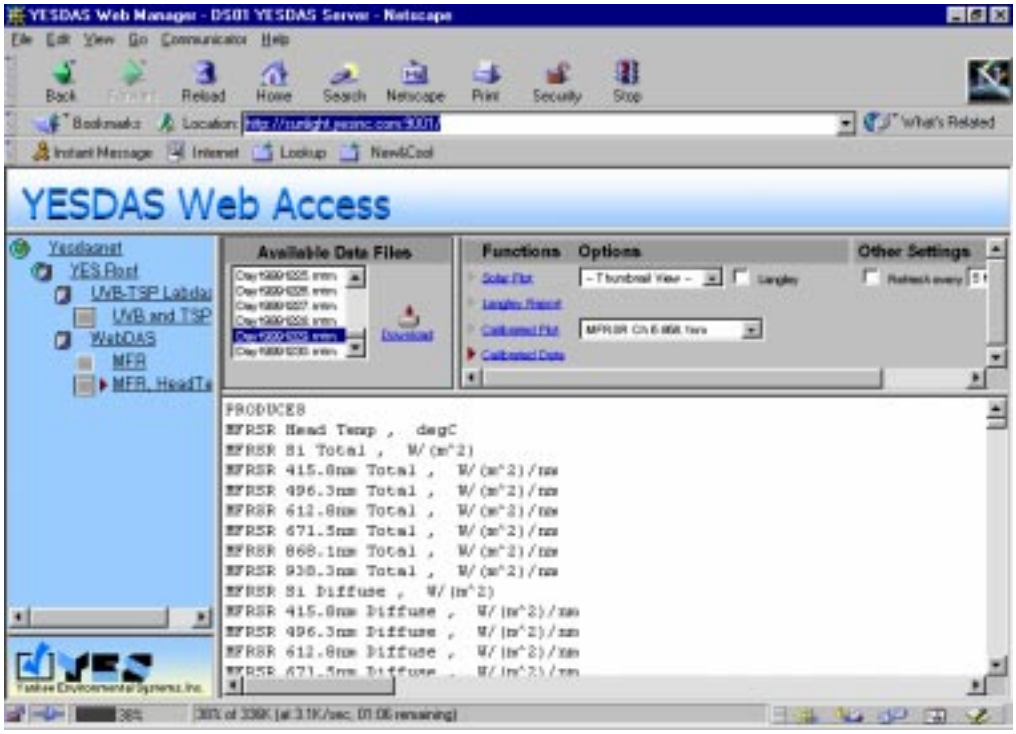
2 Click on the download icon in the available files window.

3 Select the data series you want and copy it to the clipboard.

4 Open MS-Excel and select File>Open.

5 Paste into the MS-Excel file open dialog—it will import the data for you.

Using the Web Browser interface to import into a MS-Excel worksheet.



Note: This method requires MS-Excel 97 or later.

Menu Reference

This chapter provides detailed descriptions of each menu item in YESDAS Manager. Use this chapter as a reference or to explore some of the more advanced capabilities of the program. Keep in mind that if you are using the YESDAS Automated Attendant component to retrieve data from your remote site(s) and the YESDAS Web Server to publish data to users via browsers, most of these functions are only required for debugging configuration problems. Typically, the most common problems encountered during the routine operation of a network are:

- Phone line problems (e.g. random communication modem dropouts)
- Remote site AC power failures (why you need a battery)
- Disk or server volume full problems on the PC workstation itself

YESDAS Manager follows many of the conventions used in MS-Windows applications, and supports the button 2 operation (this is the right button for a right handed mouse setup), to access the properties of the currently highlighted object. This means there are typically several ways to gain access to a given function:

- Click on a pull down menu
- Click on a toolbar shortcut
- Click the 2nd mouse button an object in the YESDAS Explorer or Data Manager windows, then select an item from the pop-up context menu
- Click the 2nd mouse button an area in the current active window, then select an item from the pop-up context menu

In addition to using the menus to open and work with files, any file ending with **.xmd** or **.mtm** are registered as a YESDAS binary data file. If you double-click on these file types YESDAS Manager will automatically launch and unpack the data for you.
The functional listing in this section is grouped by menu order generally from left to right. Because they are largely autonomous, the YESDAS Web Server and Attendant system tray components are not documented here, but some information is contained as help information in the programs themselves.

File Menu

New

Invokes the YESDAS Wizard to create a new YESDAS network. A YESDAS network is a collection of hierarchical objects (sites, YESDAS-2 systems, and profiles) that represents your physical data collection system. Normally you will only have one network, but you can have as many as you wish. It is often useful or educational to create a test network to try new settings without altering your "live production" network.

Open YESDAS Network

Opens an existing YESDAS Network. Note that you do not have to close the network each time you wish to leave YESDAS Manager as it closes the Network for you automatically. Once you open and work with a network it may appear on the most recently used list under the File menu.

Close YESDAS Network

Closes a currently open YESDAS Network. Since you can only have one network open at a time you must use this function (or alternatively, select the "X" on the YESDAS Explorer menu bar) before opening another network.

Print Setup

Like most MS-Windows programs, this item lets you configure your printer device to suit your needs. It invokes the operating system's installed printer drivers to let you configure the settings for the default printer. YESDAS Manager supports printing through standard MS-Windows printer drivers.

Most Recently Used Files

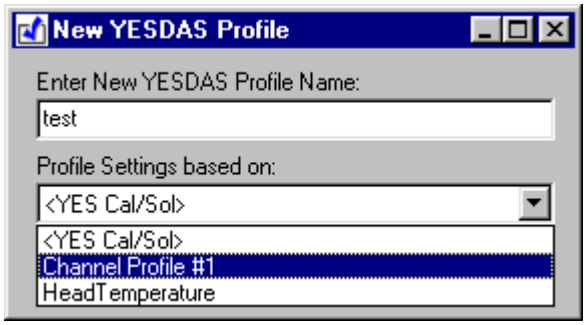
As with many MS-Windows applications, YESDAS Manager keeps the four of your most recent Networks in a most recently used list under the File menu. You can use these shortcuts to rapidly open the network used in a recent YESDAS Manager session.

Action Menu

The Action menu changes depending on the context. All possible choices are listed here.

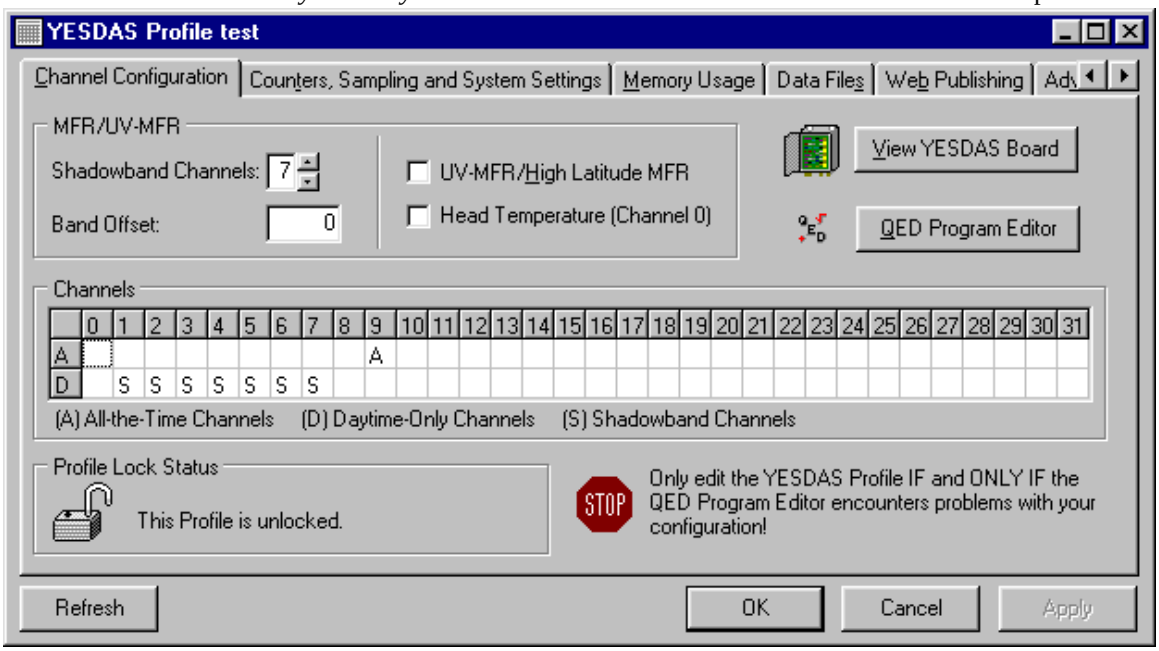
New YESDAS Profile

Profiles are a mechanism to track hardware configuration modifications over time. This menu item permits you to create a new profile for a YESDAS-2 at a site. Profiles match changes in the sampling rate or number if channels (the *data acquisition protocol*). They can be based on an initial set of default .cal/.sol files but can also be based on a previous



profile. Below is the initial new profile dialog box.
New Profile selection dialog. Typically you build on a previous profile and alter it to track new changes.

Once you proceed with the selection a new profile item appears in the YESDAS Explorer window and you are presented with the main initialization window. Note the several tabs across the top of this window, these permit access to several other critical dialog boxes:
An "unlocked" New Profile configuration window, indicating no active data files.
Note that channel 9 is turned on as an "A" or *all-the-time* channel, and the other choices are D for *daytime-only* channels and blank for *inactive* channels. Select head temperature

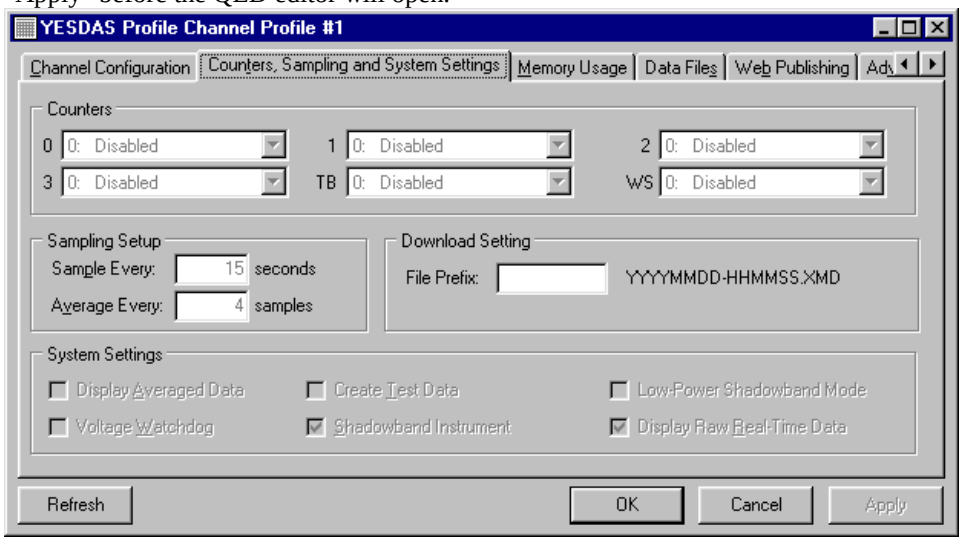


if you wish to create a new **.cal** file to permit monitoring of the head temperature, using the QED editor. Select the UV-MFR/High latitude MFR if one is connected, and then modify the band offset as necessary for these to-from instruments (otherwise leave the offset at 0). Also note that the unlocked padlock indicates there are no data files already associated with it—you can modify the profile at this point. However, once you start taking data under this configuration the padlock becomes "locked" and you will then need to create another new profile if you wish to modify any of the parameters.
To complete the dialog entries you will need to know your specific hardware configuration, in terms of what sensors are wired to what input channels. Unused channels are left blank to disable them, saving system memory.
If a shadowband radiometer is connected to the YESDAS-2, select the number of shadowband channels to be monitored based on the shadowband models:

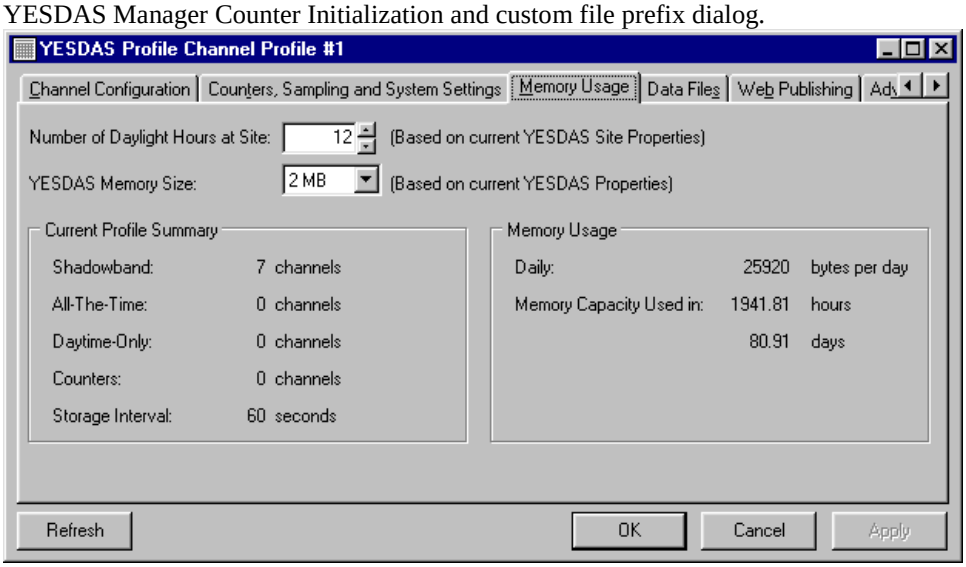
- SDR-1 or SDP-1 instruments have one channel
- SDP-2 has two
- UVMFR-4 has four
- MFR-7 or UVMFR-7 has seven

This is the same as typing the **Numbers** command at the terminal window. Next, if one of the above shadowband radiometers is connected, decide whether to enable the head temperature monitor. Note that this requires you to create a new **.cal/.sol** file set to permit the additional channel to be processed successfully.
Check if there is a high latitude (above 50 degrees latitude in the northern hemisphere or below 50 in the southern hemisphere) or a UVMFR is connected. This ensures that "to-and-fro" shadowband motion is accommodated by limiting the sampling rate to 20 seconds.
If you have any auxiliary instruments wired to YESDAS click on their channel, just once for "all the time-A" logging, and twice for "daytime only-D" logging.
Select View YESDAS Board if you need to review the hardware channel assignments.

Select QED Program Editor once you have setup the channels you want to log. This permits you to edit your **.cal/.sol** files to match the new profile. You must first select "Apply" before the QED editor will open.



YESDAS Manager Counter Initialization and custom file prefix dialog.

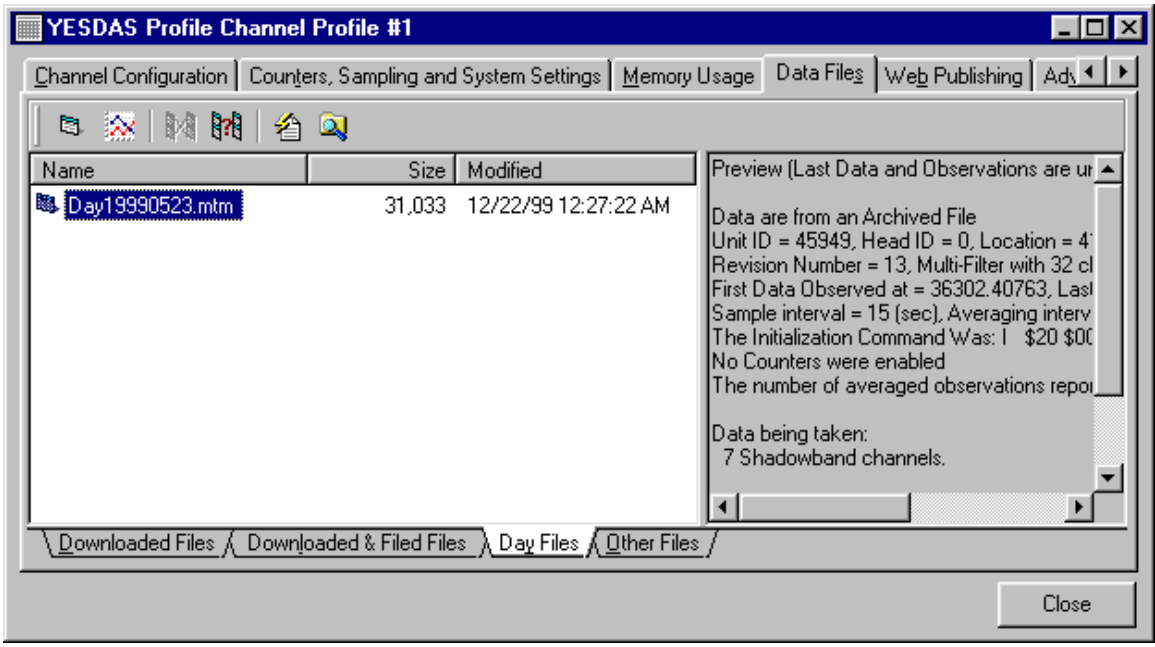


Site-specific Hours of Daylight Estimation dialog, for Memory Usage calculation.

Enter the number of daylight hours you expect the site to receive. This number is used to calculate expected "time to full" for the data buffer or the PCMCIA expanded memory option for the YESDAS-2 system. You may want to leave this as a worst case, or modify it through the year. It does not govern any data collection at the YESDAS-2 itself, as the solar ephemeris calculation within the YESDAS-2 hardware knows when the sun is up or down.

Data Files

As files are collected using a profile, they accumulate into a directory below it. Normally you do not need to know their exact location, and names are created automatically. The Data Files tab is a filtered view of the directory, helping you focus on the objects you need to see.



Data Files view, showing one *midnight-to-midnight* **.mtm** day binary file.

The data files view shows all previously collected data from the YESDAS-2 system using this profile. The lower tabs on the window show filtered views of the data directory for the current profile. Incoming files are placed in the first tab, then as they are merged they are converted into non-overlapping continuous day files. Using the YESDAS Attendant, as data files are collected by the Attendant they move from left to right until they created day files which are used by the YESDAS Web Server. The day file shown above is a binary file that was created from several merged discrete **.xmd** binary files into a contiguous, non-overlapping data file. Note the summary data on the right, which contains details about the selected file.

Initially the data files tab will be empty since you have yet to download any binary files. Downloaded files from the YESDAS Attendant are palced first in the left tab and are stored in the day tab. This data flow from left to right is part of the automation of the orgainzation of contiguous data files and permits data presentation via YESDAS Web Server.

The other three tabs can be modified or left alone for now.

- The web publishing tab permits you to assign the data from this site with a web server, (assuming that you have already created one)
- The notes tab is there for your convenience to track any details about that site
- Only modify the advanced tab if you have extremely high channel counts enabled on the YESDAS-2; normally the default value of 5 is sufficient for nearly all cases.

Delete

Deletes the currently selected object in the YESDAS Explorer. Objects can include sites, YESDAS-2's and profiles. Note that binary data files are not deleted, you must do this manually with the MS-Windows Explorer. Always retain backups of your binary data files.

Warning: Unlike MS-Window's Explorer and recycle bin, YESDAS Explorer objects that are deleted *cannot be undeleted*. Although YESDAS-2 data files are never deleted by this function, this menu item should be used with care. Alternatively the delete key can also be used to delete selected objects.

Rename

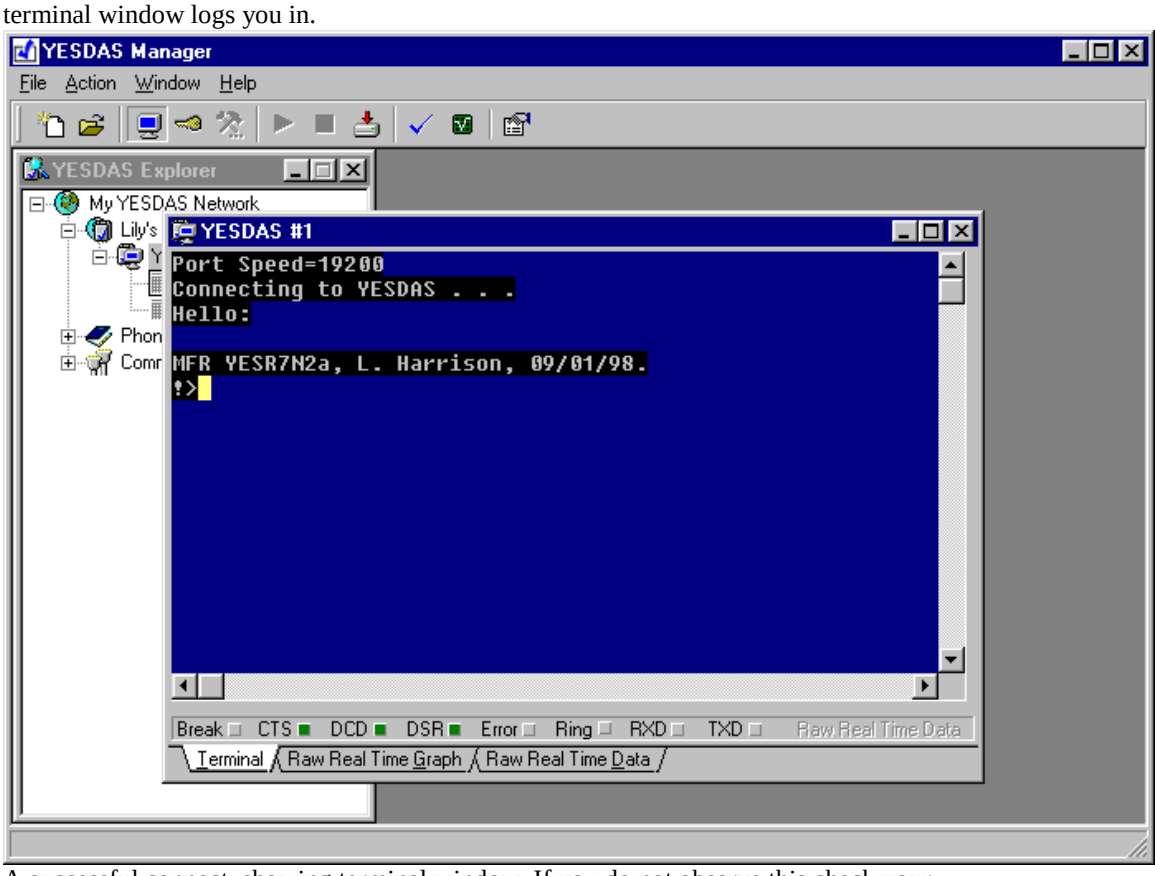
Renames the currently selected object in the YESDAS Explorer.
Note: Renaming an object is often a good way to avoid having to delete is. Although YESDAS-2 data files are never deleted by this function, this menu item should be used with care. Alternatively the delete key can also be used to delete selected objects.

Refresh

Similar to F5 - simply refreshes the tree in YESDAS Explorer if you made a change.

Connect

You must be actively connected to a YESDAS-2 system to be able to perform any data retrieval or initialization actions. This menu item will be inactive until you select an existing YESDAS-2 system from a site within the YESDAS Explorer view. Once highlighted select Connect (or click button 2 on the object, connect) and watch as the terminal window logs you in.



A successful connect, showing terminal window. If you do not observe this check your serial cable, or if connected via modem, the phone number for the remote site.
Once you are connected other **Action** menu items become selectable, such as

- Disconnect (ends the current communications session)
- Login as Supervisor (which then enables you to start and stop data collection and initialize)

- Receive (passively retrieves data from the remote data buffer to a local data file, manually)
- Status (passively checks the system status)
- Real Time Data. (turns on passive local display of real time raw data)

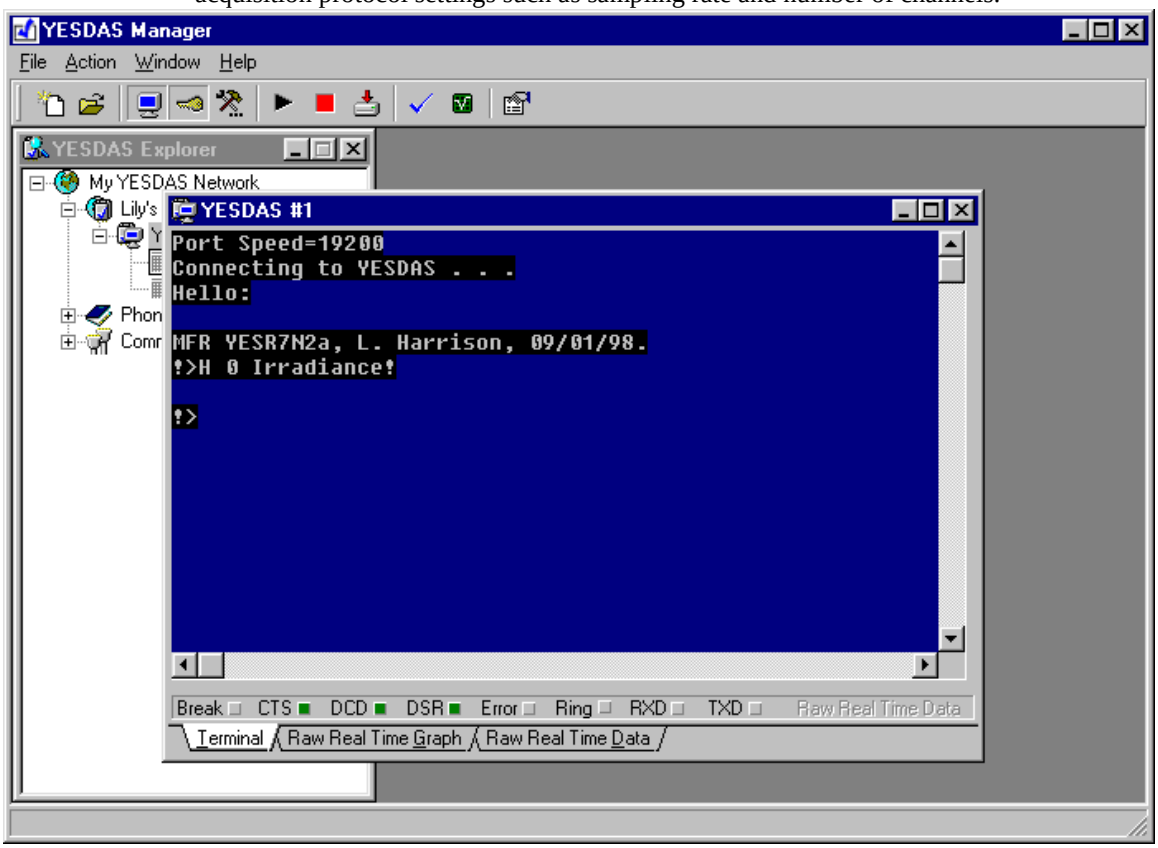
Keep in mind that at this point you are not yet logged in as *Supervisor* (so you cannot start and stop the remote YESDAS-2 system). However you can retrieve data from it non-destructively as well as check the status and turn on the real time data display. Note: YESDAS Manager's advanced multi-threaded design permits you to have up to four concurrent communications sessions open simultaneously, letting you work with up to four sites simultaneously. Each session shows up as its own terminal window. This feature permits, for example, a locally direct-connected YESDAS-2 system to display real time data while YESDAS Manager performs dial ups to one or more remote systems via modem(s). Your PC must have the required serial port and modem resources for such multi-port operation. By using modems many sites can be accommodated via the YESDAS Attendant.

Disconnect

This function terminates an active communications session. This item is only selectable if you are actively connected to one or more sites. It applies to the currently active (selected) terminal window. If you have more than one window open, be sure to select the correct window you wish to disconnect from before selecting **Disconnect**.

Login As Supervisor

You must be actively connected to a YESDAS-2 system to be able to activate this menu. (If not, first select an existing YESDAS system from a site within the YESDAS Explorer view. Select Connect, or click button 2 on the object, then connect. Observe the terminal window log you in.
Once you are connected to a YESDAS-2 system, *Login As Supervisor* boosts your privileges up from a normal user login to the supervisor level. Supervisor level users can stop and start the hardware (which clears memory) as well as reconfigure the data acquisition protocol settings such as sampling rate and number of channels.



Successful supervisor level is entered after selecting "Login as Supervisor"
The Login as Supervisor function is the same as entering:

`H 0 Password`

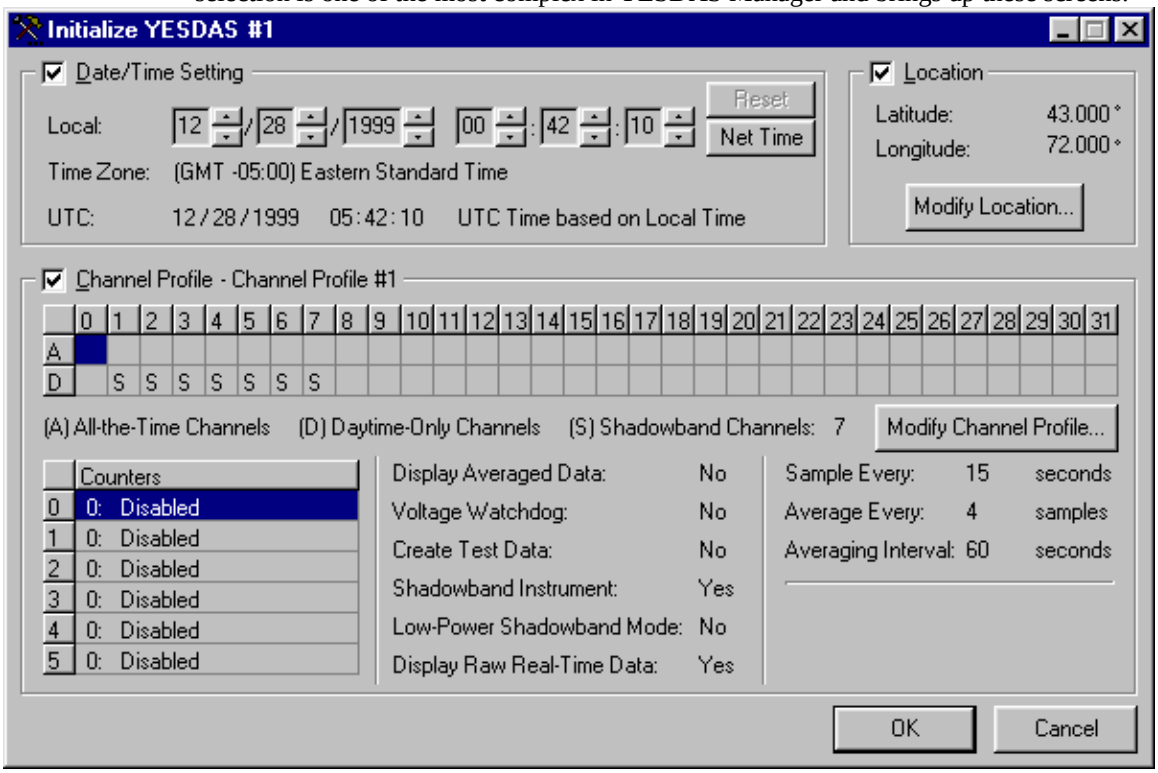
Directly at the terminal's command line, where "*Password*" is your YESDAS-2 system's case-sensitive supervisor password.
Note: If you cannot recall your password it is usually located as ASCII text in the **.cal** file for the system as a comment. Select the remember password option to tell the program to store the password so you do not have to enter it each time. Keep in mind both the User and Supervisor passwords in YESDAS are hard-coded in the firmware and cannot be changed. These primarily exist to thwart hackers who discover the phone line from tampering with or otherwise bothering your YESDAS-2 system while it is connected to the public telephone network. Be careful about disseminating the Supervisor password to unauthorized persons.

Initialize

This supervisory-level function reinitializes YESDAS-2's data acquisition protocol (sampling rate, time/location, etc) and should be used only once you are familiar with the ramifications to downstream data files, and the inability to merge data files with differing numbers of channels active.

Important: Always stop a YESDAS-2 before selecting the Initialize function.

To run the Initialize Command you must first login as supervisor. Once the Initialization command is run the YESDAS-2 is stopped, and restarted, clearing the buffer. This menu selection is one of the most complex in YESDAS Manager and brings up these screens.

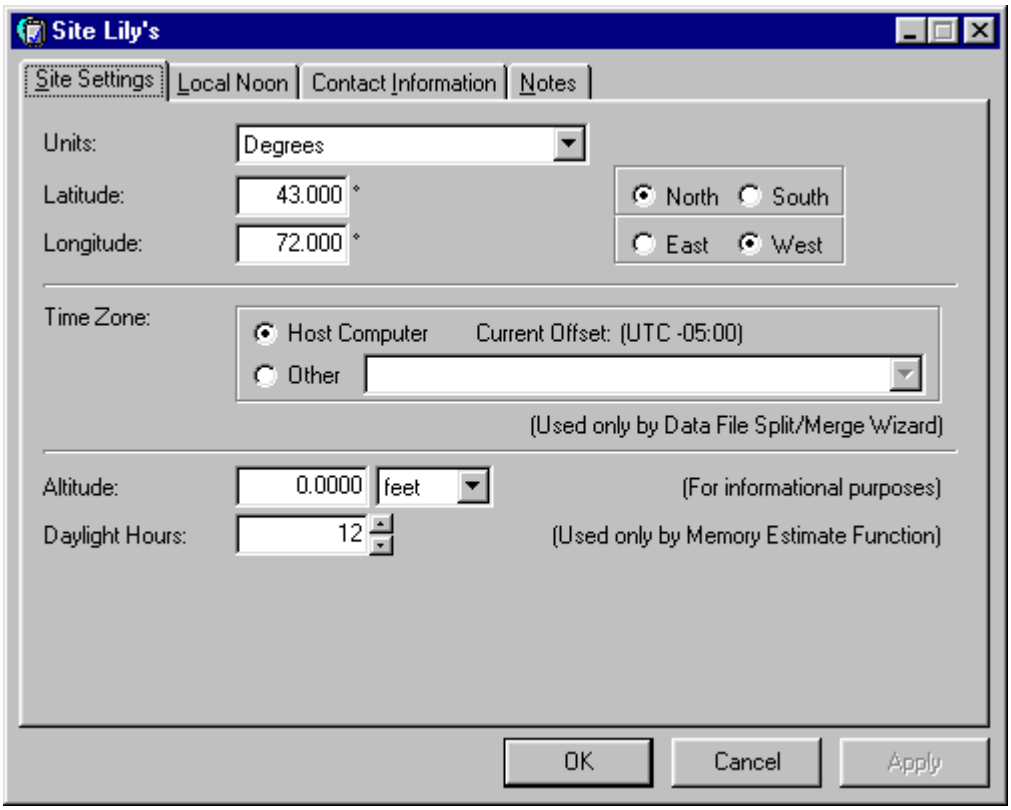


Initialization Screen. Select "Net Time" if your workstation is connected to the Internet to synchronize the time from an atomic clock time server.

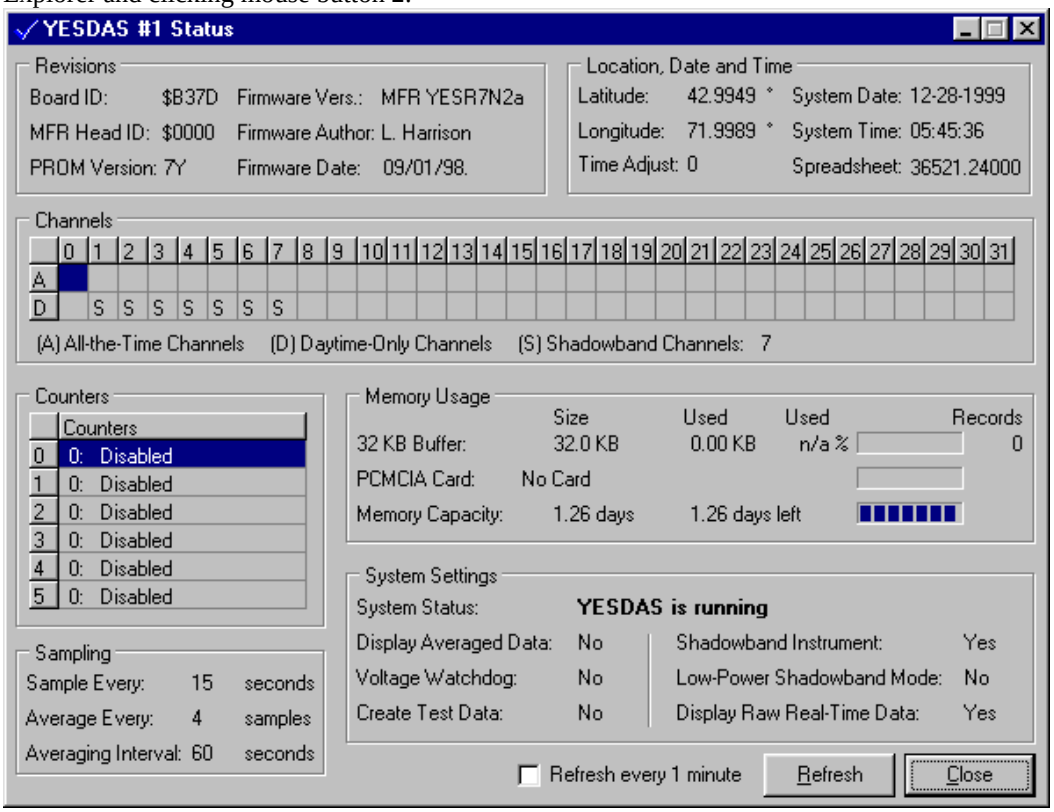
Note that some of these settings should be static, for example you normally do not move the location of the site—in this case you would create a new YESDAS-2 site and give it a new name.

Behind the dialog boxes, the initialization command actually issues a *Number* command, a J *Counter* command, and an I *Initialize* command. However due to the close ties between the initialization of a YESDAS-2 and the required **.cal/.sol** files, it is strongly recommended that you not enter these commands directly from the command line. Instead, use the New.Profile menu to add new profile to the site. This will help to effectively synchronize the **.cal/.sol** files with future data files that will be created using the new sampling protocol. For more information refer to your *YESDAS Installation and User Guide* for the exact syntax of these commands. As with other Supervisor-only commands, this menu item is not selectable until you first login as supervisor.

Modify Location



Site-specific information, also accessible by selecting the site object in YESDAS Explorer and clicking mouse button 2.

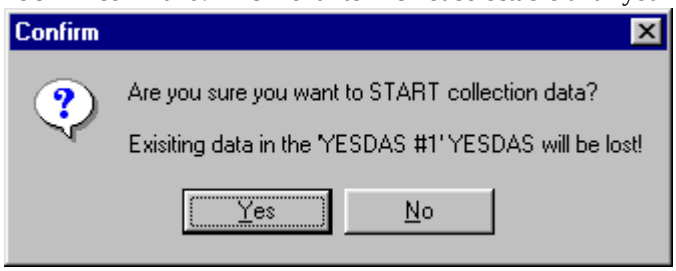


Once the initialization sequence completes, if you left the "show status" box checked, YESDAS Manager displays a status window to permit you to monitor the YESDAS-2 system operation and verify that the settings are what you wanted. Under the *System*

Status at the lower center, check for run-time errors that may indicate YESDAS or shadowband instrument problems.

Start Data Collection

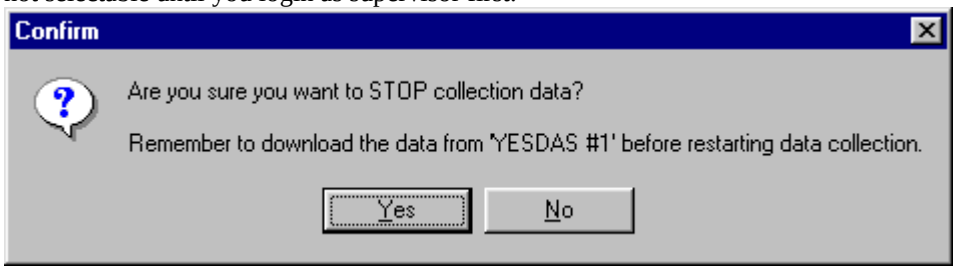
This supervisory-level function starts data collection if YESDAS-2 is stopped, and *clears the memory* in the YESDAS-2 hardware. If YESDAS is stopped this will start the system via a
"**`Go 1`**" command. This menu item is not selectable until you first login as supervisor.



Important: Starting the logging of data (also referred to as initialization) permanently clears all data from the storage buffer in your remote YESDAS-2 hardware. Be sure that you have retrieved all data from the remote system you may want to look at later before you select this menu item.

Stop Data Collection

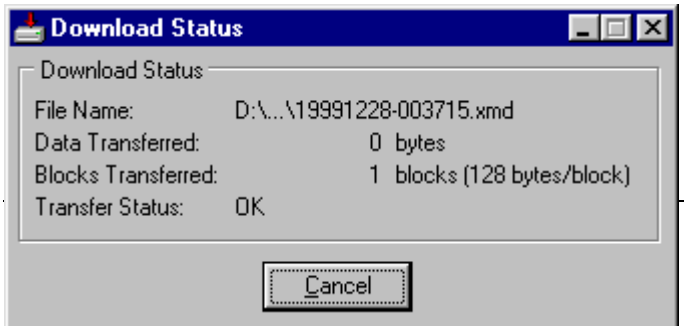
This supervisory-level function stops data collection if YESDAS-2 to permit changing the time, location or data acquisition sampling protocols in the YESDAS-2 hardware. If YESDAS is running this will stop the system via a "**`Go 0`**" command. This menu item is not selectable until you login as supervisor first.



Note that merely stopping the YESDAS-2 does not clear all data from the storage buffer. However, *once it is stopped you must eventually restart* it. Hence, you will eventually have to retrieve data from the YESDAS-2 buffer since it will be erased at startup. If you desire long term contiguous data, this is not a good idea. Once YESDAS-2 is stopped, during this time a time gap can appear in the data stream, since the data download can take several minutes depending on the buffer size (or worse case many minutes if a large 2 Mb PCMCIA option card is installed and the modem speed is slow). Typically, YESDAS-2 systems are not stopped and data is retrieved while they runs, usually via the Auto-Attendant. Before selecting this option be sure you understand the consequences down the road, as it is not possible to restart without erasing data. may want to look at later before you select this menu item.

Receive Data

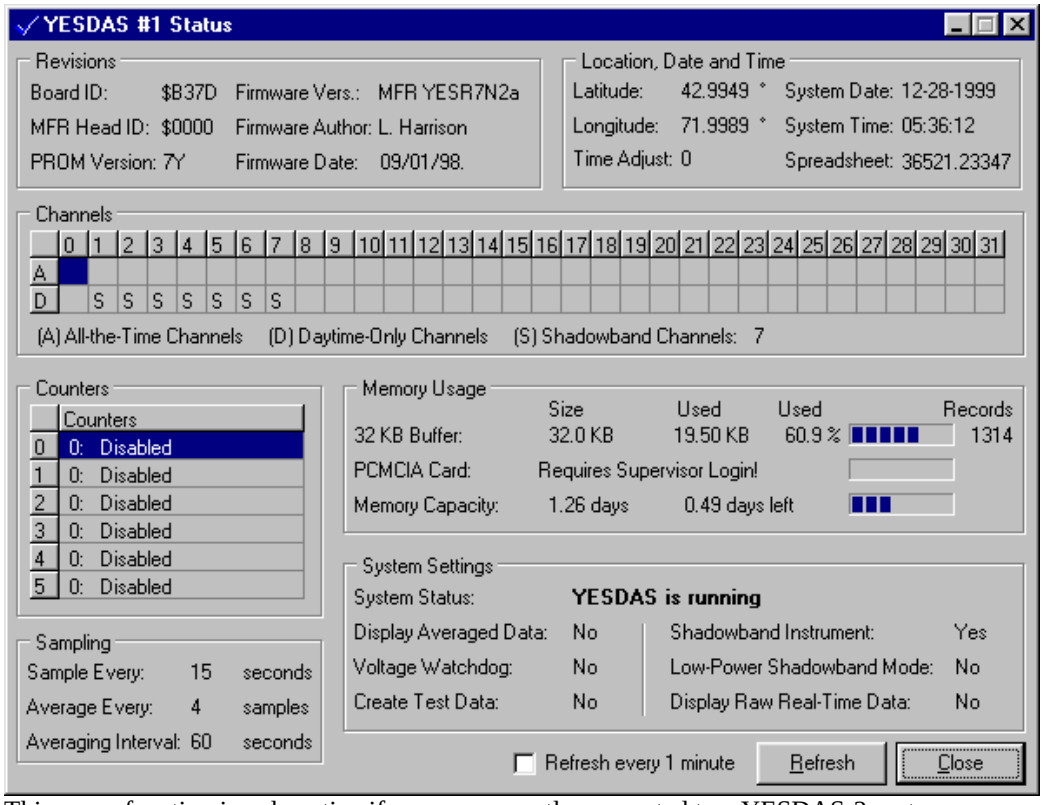
Your YESDAS-2 hardware has a remote memory buffer connected to a temperature-insensitive multi-channel analog to digital converter front end. Data stored in the buffer are retrieved to your workstation before you work with it. This menu function



automatically receives a data file from a remote system via Xmodem-checksum and stores it in a new data named by the date and organized by site. Once you begin the transfer you should observe a download dialog box similar to the one here.
Note: this function does not process data thought he Merge facility.
This menu function is only active if you are currently connected to a YESDAS-2 system.

Status

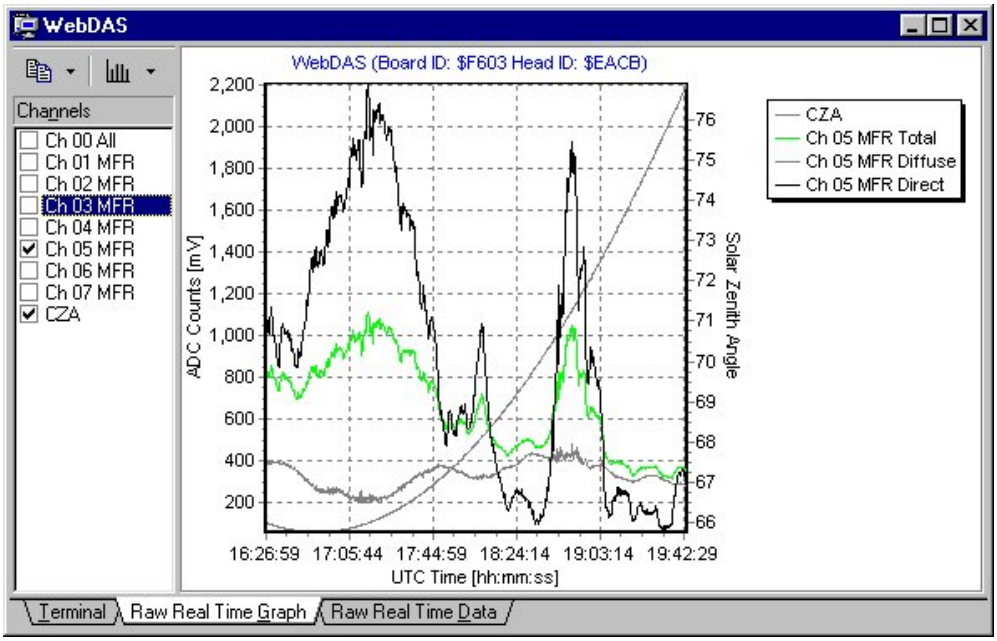
Status provides you with a great deal of detail about your YESDAS-2 hardware, whether it is currently taking data or it is stopped. You do not need to become supervisor to run this command.
YESDAS Manager status window.



This menu function is only active if you are currently connected to a YESDAS-2 system.

Raw Real Time Data

Once you are connected to a YESDAS-2 system and it is running, you can select this option to observe raw (uncalibrated) A/D converter counts for all enable channels. This function is passive and does not modify the profile or any other settings in the YESDAS-2 data acquisition protocol. Selecting this **real time display** menu item is the same as selecting the center tab in the terminal window, or the shortcut button in the toolbar.

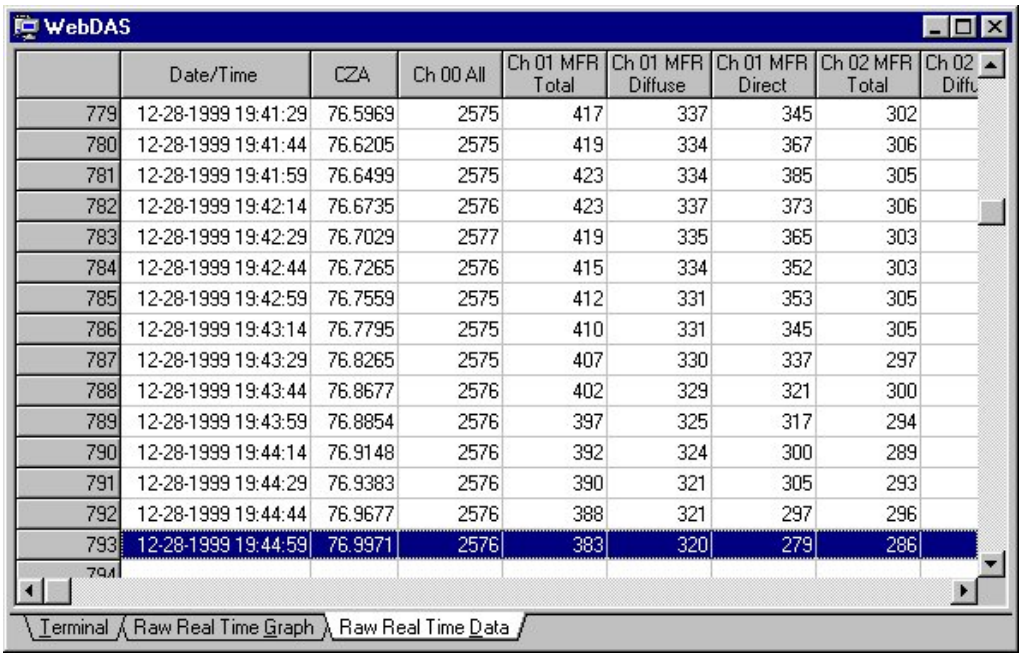


Raw Real Time data View. Note the checkboxes that determine which channels are displayed - in this example channel 5 (which has three direct/diffuse/total signals), is active along with the solar zenith angle.

In the upper left corner of the real time graph are two controls; one selects a menu of graph output options that are useful for presentation. You can copy to the MS-Windows clipboard or save as either a bitmap (.BMP) or MS-Windows Metafile (.WMF). Depending on the tool you use to present the data to, one format may work better than another; metafiles are more compact than bitmaps, but often bitmaps look better when imported. The second control graphs the data as a two-dimensional or a three-dimensional plot.

The tabs below the graph control how real time data are displayed:

- The Terminal shows the ASCII spreadsheet time, solar zenith angle and raw channel counts data streaming in from YESDAS-2 via the serial port
- The Raw Real Time Graph shows a 2-D representation (or 3-D if selected)
- The Raw Real Time Data tab shows a spreadsheet view of the data. You can then select this data from the table using the mouse (click, hold and drag to select), and then paste it into another MS-Windows application such as MS-Excel for further analysis.



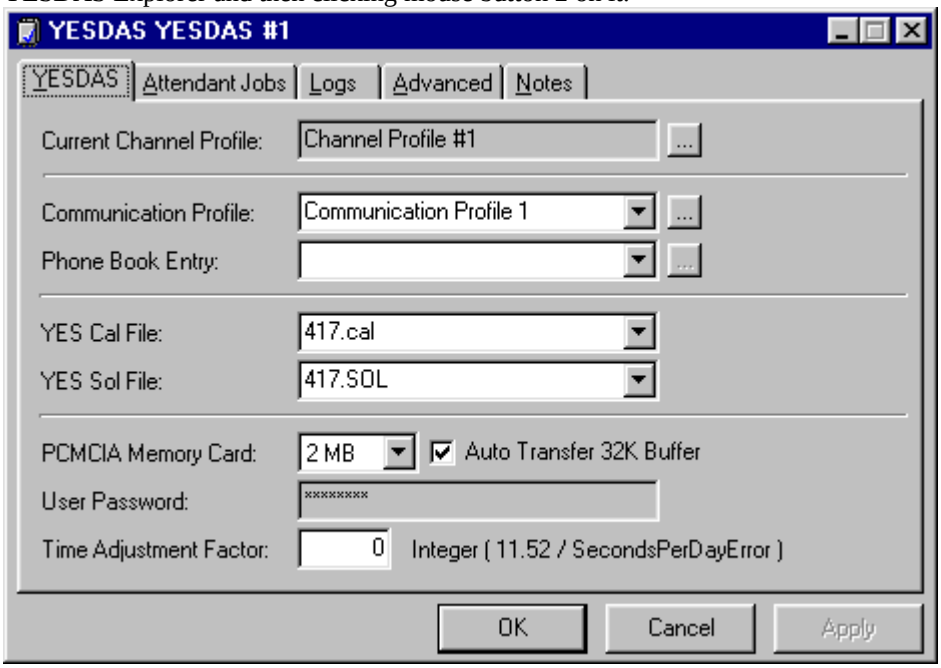
	Date/Time	CZA	Ch 00 All	Ch 01 MFR Total	Ch 01 MFR Diffuse	Ch 01 MFR Direct	Ch 02 MFR Total
779	12-28-1999 19:41:29	76.5969	2575	417	337	345	302
780	12-28-1999 19:41:44	76.6205	2575	419	334	367	306
781	12-28-1999 19:41:59	76.6499	2575	423	334	385	305
782	12-28-1999 19:42:14	76.6735	2576	423	337	373	306
783	12-28-1999 19:42:29	76.7029	2577	419	335	365	303
784	12-28-1999 19:42:44	76.7265	2576	415	334	352	303
785	12-28-1999 19:42:59	76.7559	2575	412	331	353	305
786	12-28-1999 19:43:14	76.7795	2575	410	331	345	305
787	12-28-1999 19:43:29	76.8265	2575	407	330	337	297
788	12-28-1999 19:43:44	76.8677	2576	402	329	321	300
789	12-28-1999 19:43:59	76.8854	2576	397	325	317	294
790	12-28-1999 19:44:14	76.9148	2576	392	324	300	289
791	12-28-1999 19:44:29	76.9383	2576	390	321	305	293
792	12-28-1999 19:44:44	76.9677	2576	388	321	297	296
793	12-28-1999 19:44:59	76.9971	2576	383	320	279	286

Raw Real Time data table, showing the first row of data (one sample).

Note: The raw real time data function is meant primarily to be a quick Quality Control and/or diagnostic tool, for example to check that an instrument is aligned to the sun properly. YESDAS Data Manager's display calibrated data calibration function should be used to graph and present calibrated data.

Properties

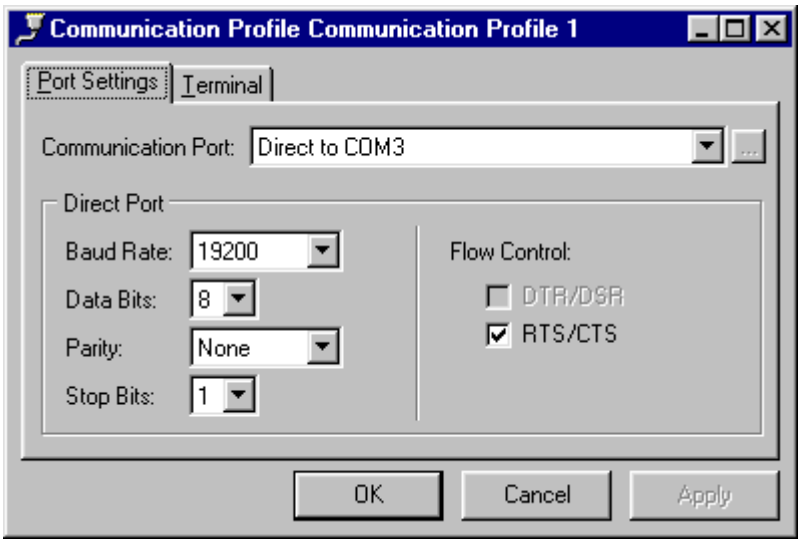
Displays the properties of the currently selected object in the YESDAS Explorer. You can access this function either by selecting the menu item or selecting an object in the YESDAS Explorer and then clicking mouse button 2 on it.



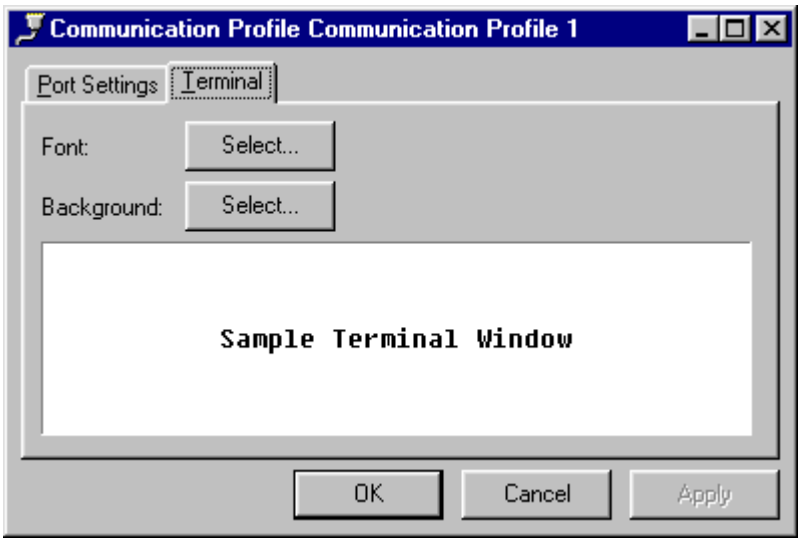
YESDAS Properties. System-specific settings are accessible from this dialog.

1 Select a suitable communications profile to use for connecting. You may have multiple profiles, for example one for a local connected system via

COM1 and a second for a modem connection to another YESDAS at a remote site via COM2. These can be created via the YESDAS Explorer by selecting the communications profile object, then press button 2 then select new.



Properties.Port Settings tab.



Properties.Communications Profile tab showing terminal options window controlling YESDAS Terminal font colors and font settings.

YESDAS Manager communication profiles use MS-Windows communications resources natively. This permits you to use any serial communications device you have configured for your PC. Be sure to select the proper serial COM port under the "Communications Port" pull down dialog, as you may have other types of serial devices connected to your PC. Be sure to verify the serial port that your modem is wired to, otherwise YESDAS Manager will not be able to communicate with your system. A quick way to do this is to type "AT" and see if an "OK" is returned, indicating that a modem is present and waiting in the offline command state.

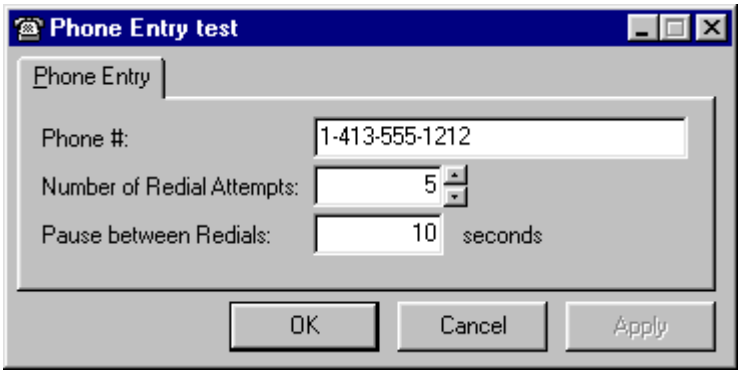
If you do not see your COM ports listed under the Communications Port pull down dialog check for:

- Incorrect PC-BIOS settings that disable the hardware on your motherboard. Reboot the PC and run the CMOS setup utility
- An errant memory-resident third party serial port driver that has taken over and hides the serial port so that no other applications can interfere with the third party application. Auto-dialers and personal digital assistant data synchronization programs are two examples of such software. Serial port hardware (copy protection) keys used by other programs you have installed on your PC are another source of problems. Try uninstalling suspected communications programs or utilities. Finally, temporarily disable virus checking software.
- Defective serial hardware or improper jumper (IRQ) settings on your motherboard that is disabling the proper functioning of your COM port(s)

  If after you check each of these and still cannot see the serial COM port listed, try exiting YESDAS Manager and disabling all system tray components. Look for programs that might be monopolizing the serial device (such as Palm Computing's HotSync application for the Palm Pilot). Next, run the Control Panel's "Install New Hardware "auto-discovery" program to see if the OS detects the new resources.

  For further assistance, refer to your MS-Windows documentation, or your local network administrator or IT specialist for help getting your serial ports to work.

  Enter a phone book entry to dial the site if the system is remote and accessed via a modem (optional if direct-wired via null-modem cable)



Entering a new phone book entry for a new YESDAS site. Enter the number as you would dial it from a standard telephone.

1. Specify the **.cal/.sol** files used as default, read in at the time the new site wizard runs

2. You must specify whether or not the PCMCIA Memory Card Option is installed and its size. Leave the "Auto transfer 32K buffer" selected.

3. The time adjustment factor permits you to software adjust the clock speed in the YESDAS hardware clock, providing very high stability, to as little as a few seconds per month. Note this number is not seconds; a complex formula is used to derive the proper value based on observed time drift over several days. You typically enter this once when the system is installed and it remains quite stable. For more detailed information see the Update command in the *YESDAS Installation and User Guide*.

Attendant Jobs

Assigns a previously created timed job to service a specific YESDAS-2 system. You can have multiple jobs per network system to support off peak dialing out via multiple modems, for example.

Logs

Permits you to view and control the size of the communications log files. These logs are very useful when trying to debug communications problems.

Advanced

Permits you to reset whether the Supervisor password is stored or not. Note: you must store the password if you intend to use the Automated Attendant to poll the site.

Notes

Text field for storing information specific to that YESDAS system (e.g. sensor configuration, expected recalibration dates, etc.

Window Menu

Tile

Fills the application with all open windows with no overlap.
Note: Like many MS-Windows applications, the lower section of the Window menu contains shortcuts to each active application window. Assuming at least one window is open, use this to jump to the window of the program that you wish to work with.

Cascade

Shows all open YESDAS Manager windows as an overlapping diagonal cascade.
Note: Like many MS-Windows applications, the lower section of the Window menu contains shortcuts to each active application window. Assuming at least one window is open, use this to jump to the window of the program that you wish to work with.

Arrange All

Similar to **Window.Cascade**, shows open YESDAS Manager windows as an overlapping diagonal cascade.
Note: Like many MS-Windows applications, the lower section of the Window menu contains shortcuts to each active application window. Assuming at least one window is open, use this to jump to the window of the program that you wish to work with.

Help Menu

Tip of the Day

Each time it runs, YESDAS Manager shows you a short "tip of the day" to help you learn the program. If you turn off this function, you can access these tips via this menu. Note that these tips are not intended to be a substitute for reading the documentation but rather are a way to get introduced to functions that you might otherwise not know about.

YES Home Page

Select this link to bring up your PC's web browser to point to our corporate web page. There you can learn about other products, read application notes or data sheets.

YES Online Services

Select this link to bring up your PC's web browser to point to our on-line services page. There you can look for updates, post bug reports to YESDAS Manager developers or ask questions.

About

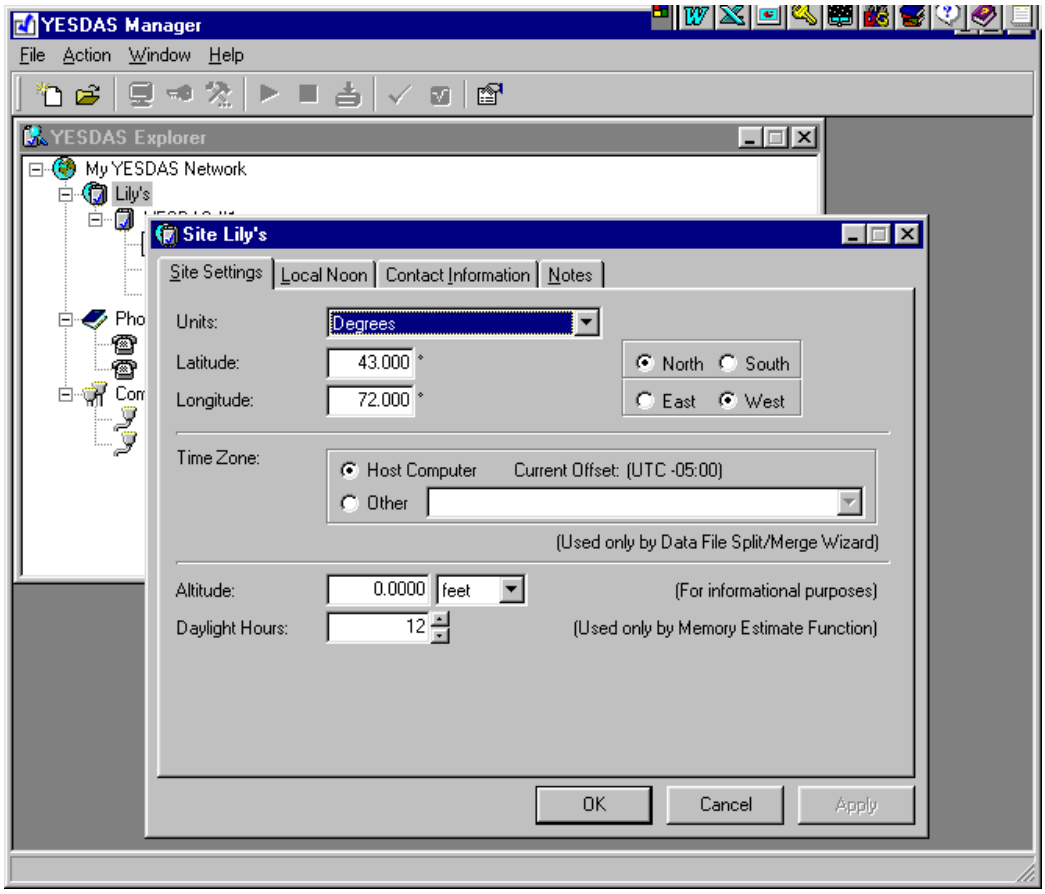
Displays the version number of YESDAS Manager that is running.

Context-Sensitive Menus

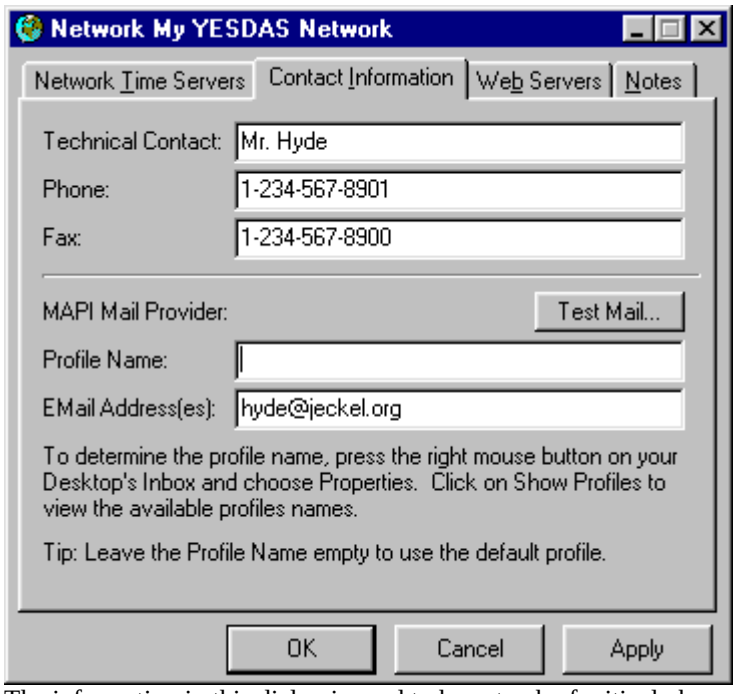
Some functions are available only by selecting the object in YESDAS Explorer and then using button two to click on it.

Site

Site-specific information such as contact is entered in the properties section for the site object. Select the time zone for the local site:
Site properties for site "Lily's"



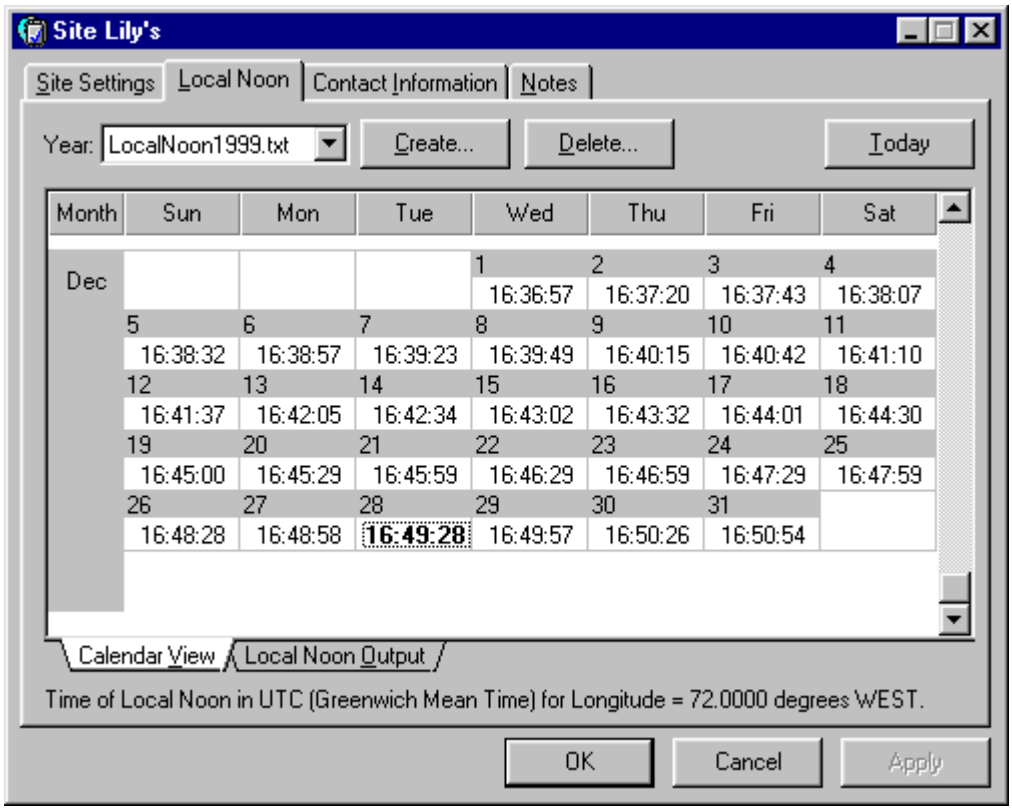
Contact Information



The information in this dialog is used to keep track of critical phoen numbers and email for site administrators and technicians. Setting up email notification is highly recommended if you have a local SMTP or MAPI-compliant email tool configured on your PC.

Local Noon

The Local Noon report produces a calendar-like view of the local solar noon times for the site—this is the time when the sun is at the highest elevation angle in the sky. The calendar runs from the current date out to a year from now. Assuming the sun is visible during the middle of the day, this utility can be very useful when initially installing a solar instrument such as shadowband instrument. Solar instruments must be precisely aligned along the local north-south meridian (*geographical N-S* not *magnetic N-S*), to make adequately blocked measurements. At solar noon each day a vertical object's shadow will be precisely aligned to geographical north. This report is an alternative to calculating solar noon using the mean of published local sunrise and sunset times.



Example local noon report calendar view tab.

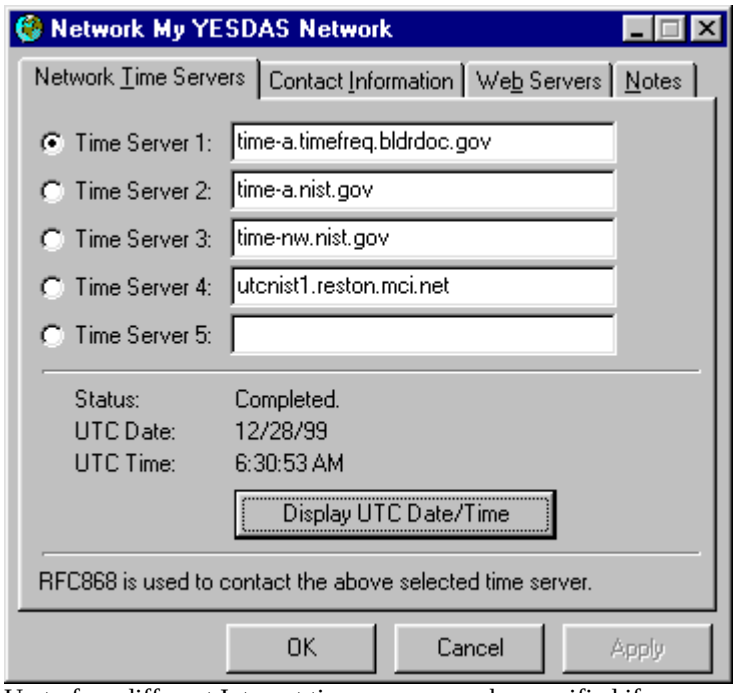
Note: Times are reported in coordinated universal time (UTC). You must add or subtract the appropriate offset to derive the solar noon for your local time zone.

Network Context Sensitive Menu

If you have a network selected and press button two, you can access properties associate with the entire network such as the time server, etc.

Time Servers

Most PC clocks tend to drift by several seconds per day. Although your YESDAS-2 hardware has very stable time-keeping, the precise alignment of your PC's time is critical in a network to keep data synchronized. You can synchronize your PC's clock to atomic time standards at NIST if you have a live Internet connection.



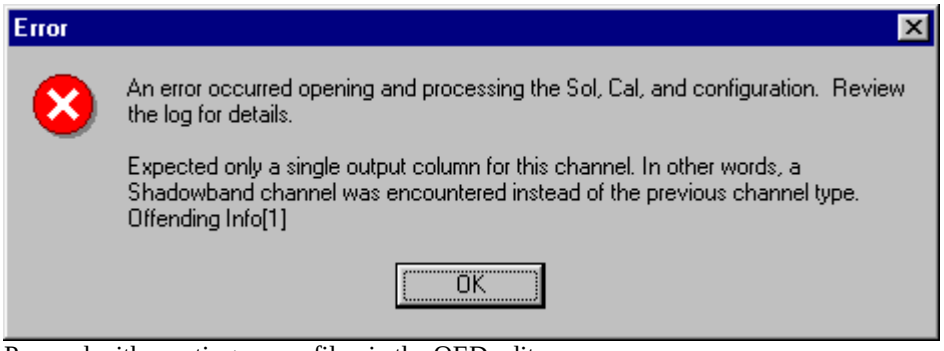
Up to four different Internet time servers can be specified if your workstation.

Initialize Context Menu

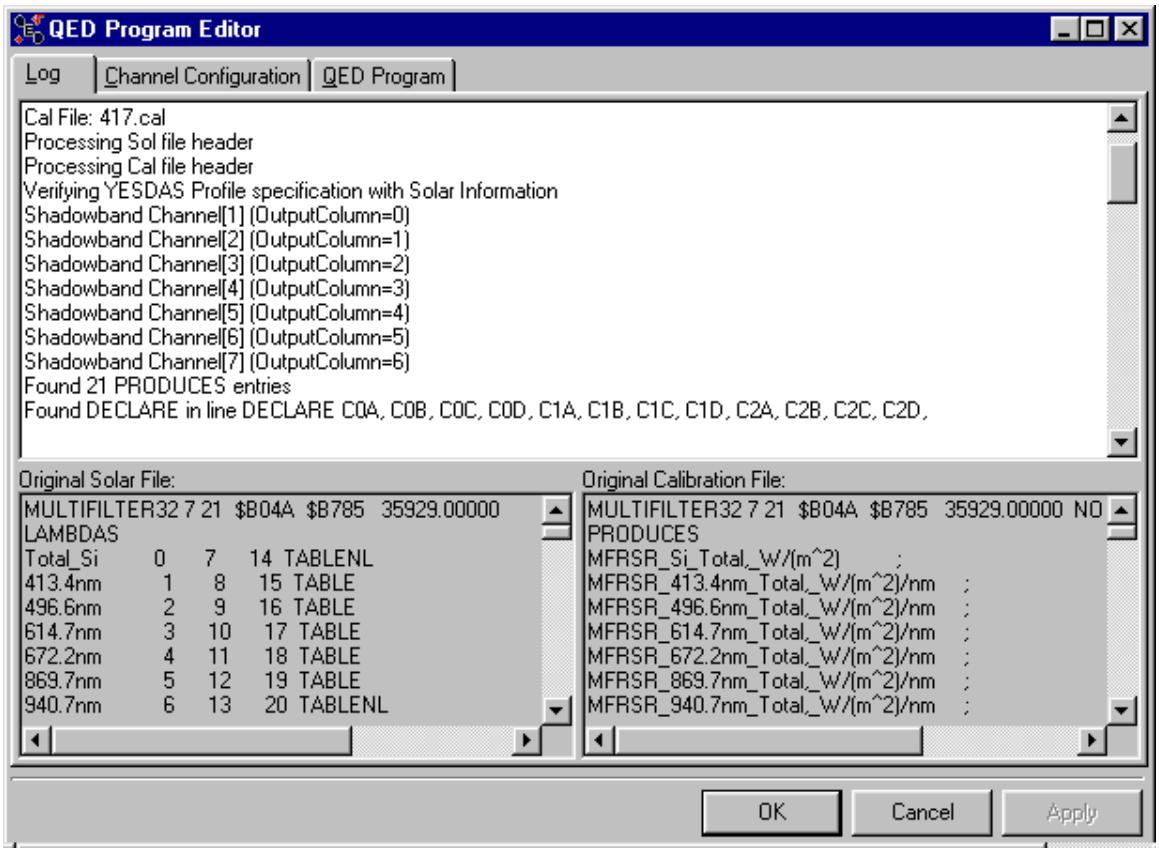
If you have a system selected in YESDAS explorer, by clicking button two you can access global functions that are specific to that particular system. Due to the flexible nature of your YESDAS-2 hardware and the many ways it can be configured, this is one of the more complex areas of YESDAS Manager. For more detailed information on how QED works, please see Chapter 5.

QED Program Editor

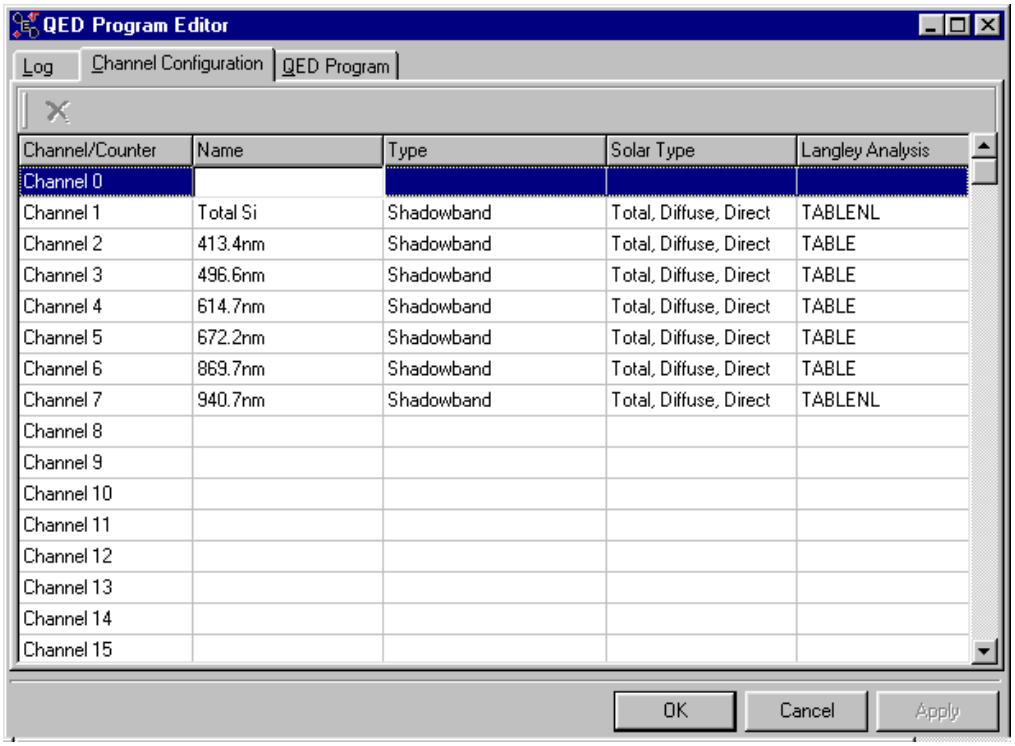
QED is a powerful data processing tool that handles the automated assignment of engineering units to the raw data stream from the YESDAS A/D converter. In addition to the information presented here, you should familiarize yourself with discussions elsewhere, or refer to your *YESDAS Installation and User Guide*.
If you have a brand new YESDAS-2 hardware system it was supplied with a default system *profile* on a floppy disk, created along with the **.cal/.sol** files by the factory. However, if this is a upgrade or a configuration change from the default you will need to create a new .cal/.sol file set to properly process the data with. Assuming you have enabled or disabled one or more channels in the new profile, the new number of data columns expected from the remote YESDAS-2 will differ from the number of channels in the current **.cal/sol** file. You should see an error message similar to the following:
Dialog showing hat the current calibration information file does not match the profile.



Proceed with creating a new file via the QED editor.

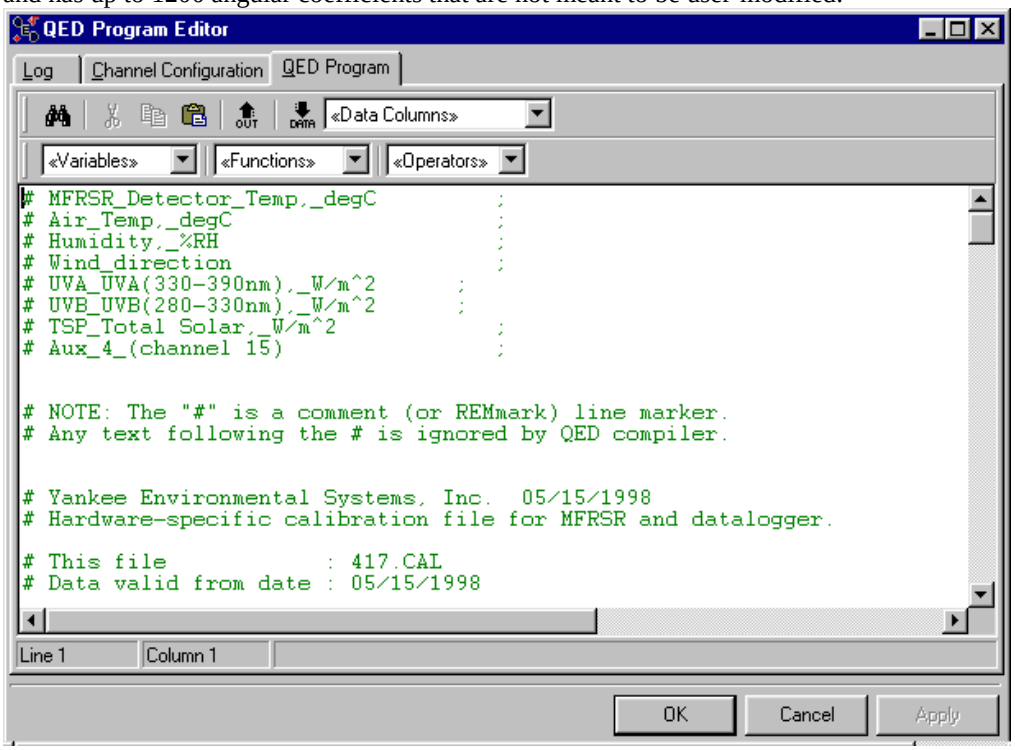


Log tab of QED editor showing editor startup (no problems are found.)
The lower two windows are read only views of the original solar information (at left) and calibration information (at right) files. These files are supplied by YES after each factory calibration.



QED Editor channel Configuration tab.
This table represents the top lines of the corresponding **.sol** file, which is created based on the default Solar Information file that was supplied with your system. Note that you

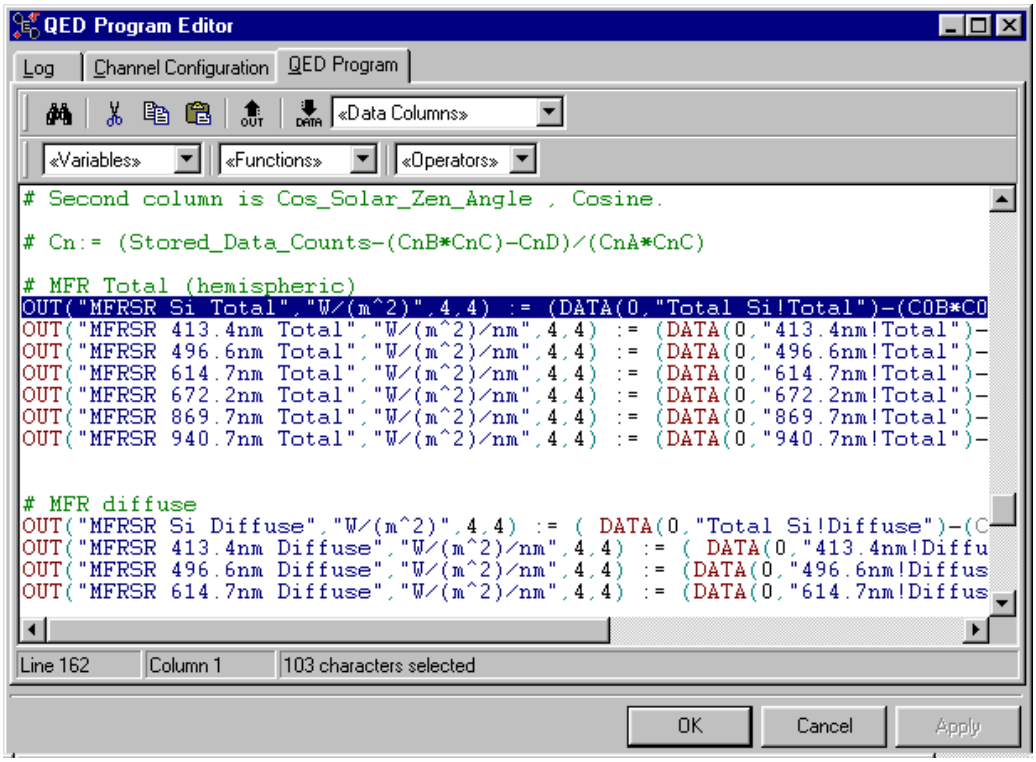
should not typically ever need to (or want to) edit the **.sol** file, as it is machine-generated and has up to 1200 angular coefficients that are not meant to be user-modified.



QED program Editor, showing top of file.

While you are editing the text in the **.cal** file in this window, the QED editor has a drop down auto-insertion capability that inserts a valid channel name or function keyword at the current cursor position. This feature helps you to avoid introducing QED syntax errors that will prevent a successful compile. When editing a new QED program to become the **.cal** file for a new profile, note that for your convenience:

- Channel names are automatically synchronized with the solar info display names
- Function keywords are highlighted in red
- Channel names are in blue
- user comments are in green,
- Variables are in gray
- Constants are in black

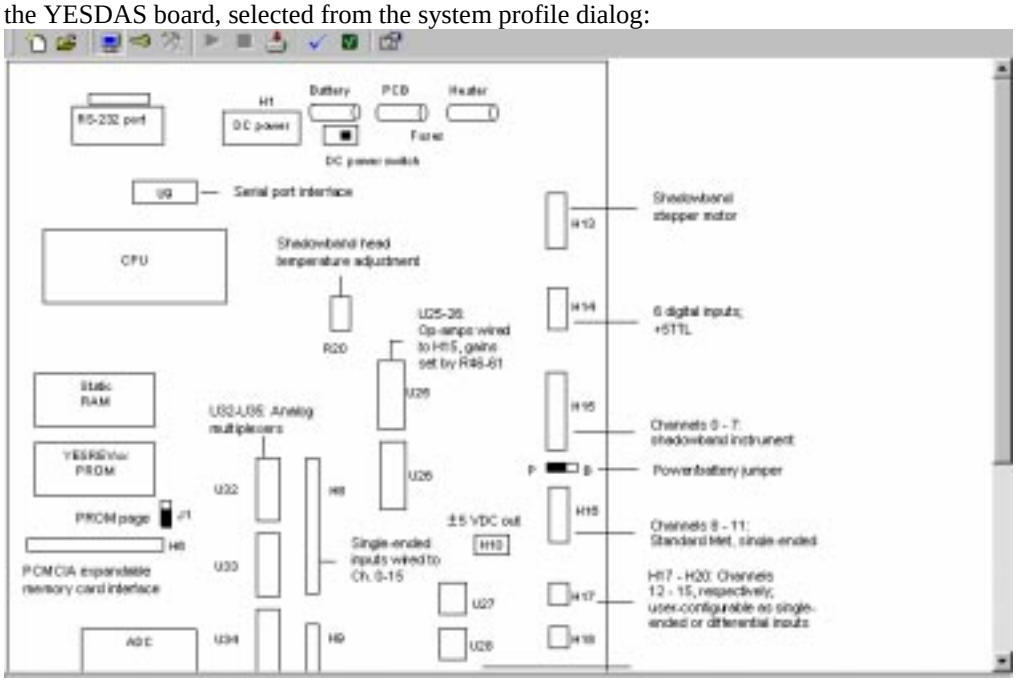


Here a QED output program statement is highlighted, demonstrating a syntax example for an output statement.

Note: The QED editor automatically inserts channel names for readability, but later converts these to numbers when the program is written out to a **.cal** file.

Viewing the YESDAS Board Layout

During the creation of new site profiles, it may be useful to refer to the on-line version of the YESDAS board, selected from the system profile dialog:



For more detailed hardware or wiring information refer to your *YESDAS Installation and User Guide*.

System Log Files

There are two types of ASCII log files stored by YESDAS Manager while it works: *system* logs and *site* logs. System logs store communications-related commands as sites are polled. Site logs only contain a history of processing information for that specific site. Reviewing these logs can be very helpful for determining configuration errors, (such as incorrect site phone numbers).

System Passwords

With YESDAS-2 systems sitting behind modems connected to the public telephone network, hackers might attempt to gain access to the system, either out of curiosity or malicious intent. To protect your data, every YESDAS-2 has two passwords, a **user level** password that can only download data and a *supervisor level* password that can reconfigure and start/stop data acquisition.

These passwords are case sensitive and are specific to your YESDAS-2 hardware. As they cannot be changed, be careful about disclosing these passwords to persons not known to you. Your user password is

`Langley!`

This password is embedded in YESDAS Manager. Your supervisor password is:

`Irradiance!`

You must enter this password to perform advanced operations such as configuring the data acquisition. If you have physical access control over your PC you can select "save password" you will not have to reenter it each time you use YESDAS Manager.

RS-232 Communications and Cable Wiring Diagram

The communications options and power requirements for YESDAS-2 are described below. Refer to the manual for your sensor (the MFR-7 shadowband instrument manual, for example) for more information on site requirements.

Serial Communications Options

Because it supports a RS-232 interface, YESDAS-2 supports several flexible on-line and off-line methods of data communication. Note that for telecommunications methods you dial into YESDAS; it never dials out.

- Hayes-compatible modem. This method requires a telephone line to the site and modems at both the site and host PC. You communicate with YESDAS by way of YESDAS Manager running on your PC, via the modems.
- RS-232 direct serial. If you have a computer at the site, then you connect a YESDAS-2's DTE port directly to a PC's DTE input via the supplied RS-232 null-modem cable letting you retrieve data. For Macintosh systems, you must connect a Macintosh high-speed modem cable (not supplied) between the null modem cable and the Macintosh computer.

  If you chose to use another cable be especially careful to verify that the hardware flow control lines are actually implemented in the cable. (This is generally referred to as a high speed cable in the Macintosh world). If you substitute a longer cable for the one supplied, be sure that it is a null-modem cable. You can legally run a RS-232 cable up to 50 feet according to Electronic Industry Association (EIA) guidelines, but with low-capacitance shielded cable, you can go up to 200 feet between host and YESDAS. If you need to go farther than this 200' distance, you will need to use either conventional telephone lines and modems, or a fiber optic serial link. If you decide to us a fiber optic link, be sure that it supports hardware flow control (many do not). Contact YES is you need help selecting one.

  A null-modem cable is a special cross-wired RS-232 cable that permits two like (DTE or DCE) devices to be wired directly together. For example, the YESDAS-2 is DTE and is meant to direct-connect to a modem, which is DCE. If you want to connect a YESDAS-2 to another DTE device (such as a PC) you need a null-modem cable. Each YESDAS-2 is supplied with a high quality null modem cable. For your reference, the pinout for this RS-232 DB-9 null-modem cable appears below. If you need a custom length, you can order one from Black Box corporation, part number EYN257H-FF (www.blackbox.com), specify length at time of order.

END A	END B
1,6	4
2	3
3	2
5	5
7	8
8	7
9	N/C

- RF modem. **If you have long distance requirements and have line-of-site between the site and the workstation, you can communicate from the host PC to YESDAS-2 over radio frequencies (RF) provided you maintain a direct line of site to the system and do not exceed 25 miles (40 km) between YESDAS and the transceiver. You connect one RF modem to YESDAS and one to the host computer with high gain directional Yagi type antennas aimed at each other. Depending on the model and type of RF modem, you might need to obtain a license to operate it.**

Because YESDAS is configured as DTE and RF modems are typically configured as DCE, you use a standard RS-232 cable to connect the modems to YESDAS and your PC. Do not use the null-modem cable you use to connect the PC directly to the YESDAS.

- **Cellular modem.** Cellular modems are essentially stationary, on-mobile cellular phones with a data interface that emulate Hayes modems using ordinary telephone land lines. You connect one to the YESDAS-2 and dial the cell phone's assigned telephone number. Cellular modems require local cellular activation by your cellular provider. Although convenient depending on the amount of use this can be a low or high cost telemetry solution. Keep in mind the following points:
  - Be aware that there are at least three cellular technologies in use in the USA, and the modem technology must match the network that you intend to use. As of 2000, there is one analog and two digital cellular networks deployed across North America, whereas a third (incompatible) digital modem technology is prevalent in Europe (GSM).
  - The physical interconnect is via a direct RS-232 cable between the cellular modem's DCE interface and YESDAS-2's DTE interface (do not use the null-modem cable.) You need to supply this straight RS-232 cable, which should be provided with your cell modem.
  - To maximize the signal-to-noise ratio be sure to buy and install a high gain directional Yagi antenna. Aim it at the nearest cell site from your remote site (you might want to contact the cellular provider to determine the closest cell site location). Some cell modems have signal strength indicators that are indispensable for alignment optimization.
  - If you are using analog cell modems, be sure to buy an external RF amplifier to boost the signal from the lower 600 mWatt RF power level to the maximum allowed 3 watt level.
  - Your cell modem will require its own DC supply. Unless it is a low power digital phone, do not attempt to run the cell modem's power directly from the YESDAS-2 DC supply. The DC current requirements of the cell modem may be quite high.

Stored Memory Data Retrieval via PCMCIA Memory Card Option

YESDAS-2 systems ship equipped with 32 Kbytes of buffer memory. For remote operation where the data are not required in real time, the YESDAS PCMCIA Memory Card option offers far greater capacity and resistance to data loss from power outages. It consists of a special firmware and a hardware daughter PCB that plugs into the main PCB board in YESDAS-2, along with a 1 or 2 Mb non-volatile memory card. The PCB adds a PCMCIA memory card slot to YESDAS and even permits *hot-swapping* the data card by untrained personnel without having to stop and restart the system. This manes that you do not have to bring a laptop to the remote site to fetch the data (although it is wise to connect one simply to check the system's status). Consider using two PCMCIA memory cards for round-robin data transfer.

The major advantage of the PCMCIA Memory card option is that it permits much higher data time resolutions. These higher sampling rates permit reduced smoothing of the data and increase the accuracy of optical depth retrievals from shadowband radiometers.

Finally, the lithium cell in each PCMCIA card makes the stored data non-volatile, preventing even a long term AC power failure at a remote site from erasing your system's data, even if the standby DC battery is completely drained.

Processing the Data

In this chapter some of the more advanced topics of YESDAS Manager are explored: how data are processed via the QED language. Each time you calibrate a sensor or change the number of channels you are observing, a new profile must be created to direct YESDAS Manager how to apply calibration constants to the raw data stream. Each profile is matched to a specific **.cal/.sol** calibration & solar information pair.
A solar information file performs automated angle correction to raw direct-normal data and supports the Harrison Objective Langley algorithm that helps to generate reliable optical depth results. YESDAS Manager profiles fully automate the creation and modification of solar information .**sol** files, however, a calibration information file is a QED program (stored as a **.cal** file) and must be created via the QED editor. The QED language is used to process YESDAS-2 angle-corrected data by applying engineering units. Other downstream data analysis algorithms such as Harrison Objective Langley analysis can then be performed on the processed data. Later in this chapter an example of adding a channel to the system is provided.

General Concepts

Each time you make a change to your YESDAS-2 hardware or modify the *data acquisition sampling protocol*, you change the number of active channels resulting in more or fewer data columns. In addition, if you recalibrate a sensor you need to tracks these calibration constant changes by creating a new system *profile*. A new profile is necessary each time you alter the number of channels being acquired or one or more calibration constants. Each profile is intimately linked to its data files and the pair of base Calibration and Solar Information files (**.cal** / **.sol**) supplied with your hardware system. And of course if you physically relocate the system new profiles also required, since the site latitude and longitude are tagged to each data file.
Although you may never actually modify the number of YESDAS-2 channels you are observing, each time you recalibrate a sensor you are entering a new *calibration epoch*, which results in changes to constants in the calibration information .**cal** file.
Each time you change the sampling rate or recalibrate a sensor or sensors on the system you must create a new set of **.cal** / **sol** files as well as a profile. You do this via the QED editor built into the configuration page for each YESDAS Profile.

Considerations in Larger Networks

Running a large network can involve processing hundreds or even thousands of files per day. As in any complex endeavor, organization and adherence to common conventions helps to minimize problems and confusion. For example, try to stick to a simple site naming convention that is both mnemonic and extensible, should your network grow in the future.

Planning a Network and Setting Up New Sites

If you are building a small or even a large network of YESDAS-2 monitoring stations, YESDAS Manager can run the entire data collection, processing and data presentation for you, provided that you plan for file system growth. If you also want to support full time real time display of data, you will need communications servers that are capable of dialing into many YESDAS systems simultaneously. You can contract YES Inc. to help plan and build your monitoring network however large or small—YES has extensive experience with creating wide area environmental data collection networks.

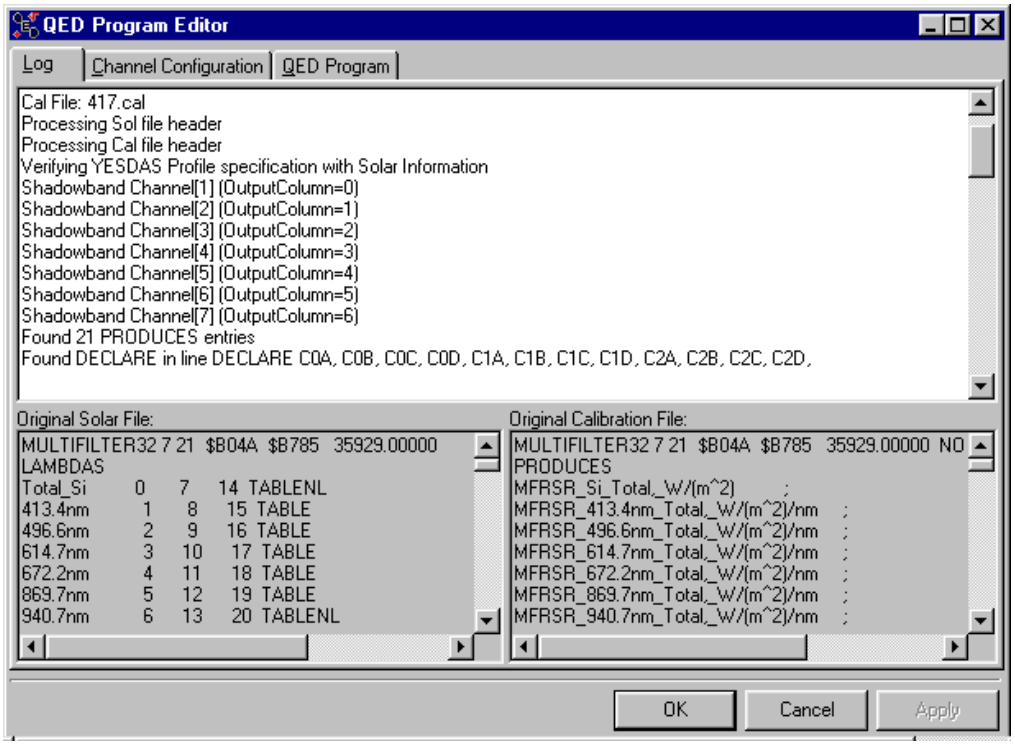
Using the QED Editor to Update a Calibration Information File

QED is a powerful data processing tool that handles the automated assignment of engineering units to the raw data stream from the A/D converter in YESDAS-2. In addition to the information presented here, you should familiarize yourself with discussions elsewhere in your *YESDAS Installation and User Guide*.

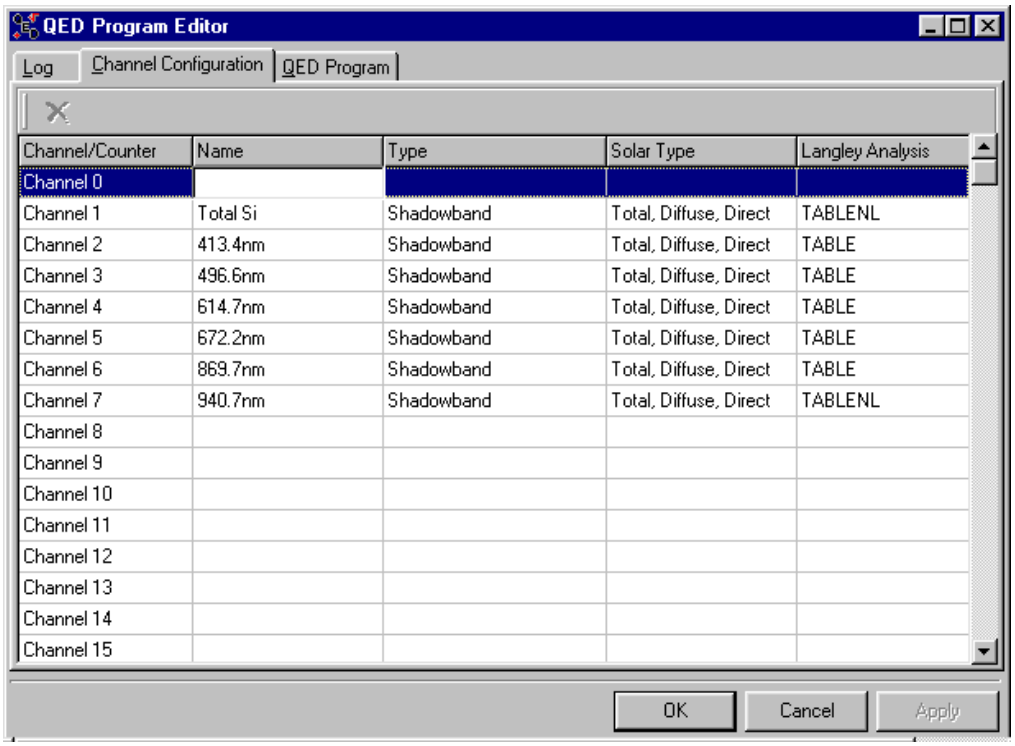
Concepts

The default **.cal** and **.sol** files supplied with your system can be used as is—without further editing—provided you have not changed your YESDAS-2 configuration. However, if you have attached auxiliary sensors that increase of decrease the number of data columns, or want to perform special processing, you must edit the **.cal** and **.sol** files. This chapter provides detailed information on the contents and syntax of these files.

YESDAS Manager's built-in QED editor

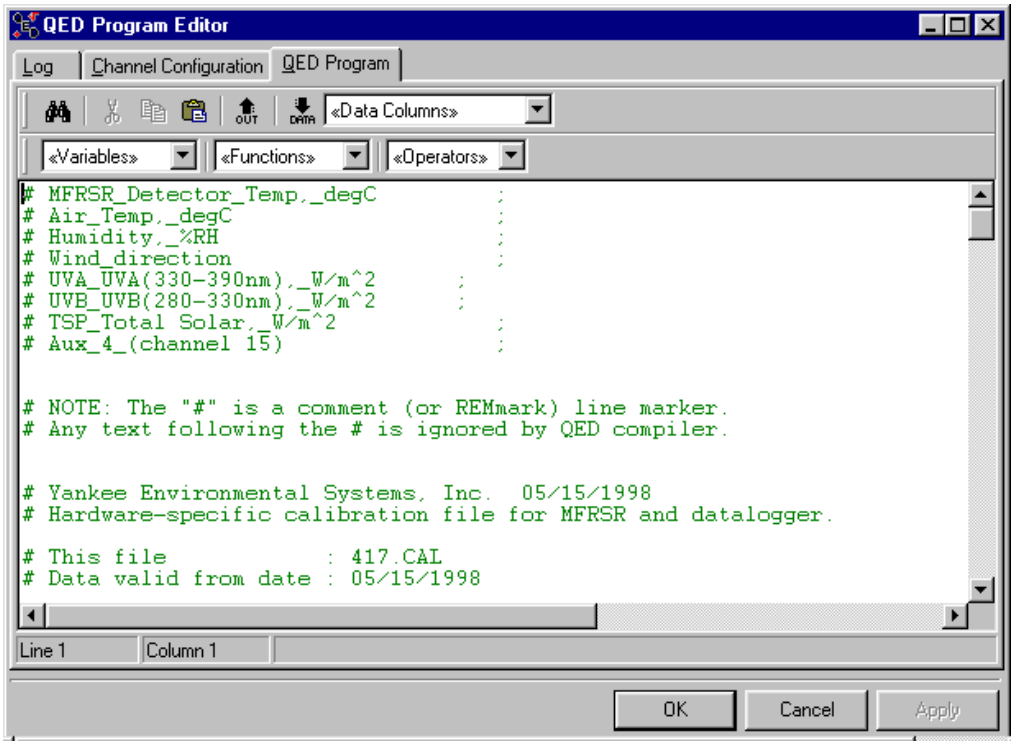


You use the built-in QED editor to modify the files or another text editor.
QED Log tab, showing no problems at startup.



QED Editor channel Configuration tab.

This table represents the top lines of the corresponding **.sol** file, which is created based on the default Solar Information file that was supplied with your system. Note that you should not ever edit the **.sol** file directly, as it has up to 2534 machine-generated angular coefficients that are not meant to be user-modified.

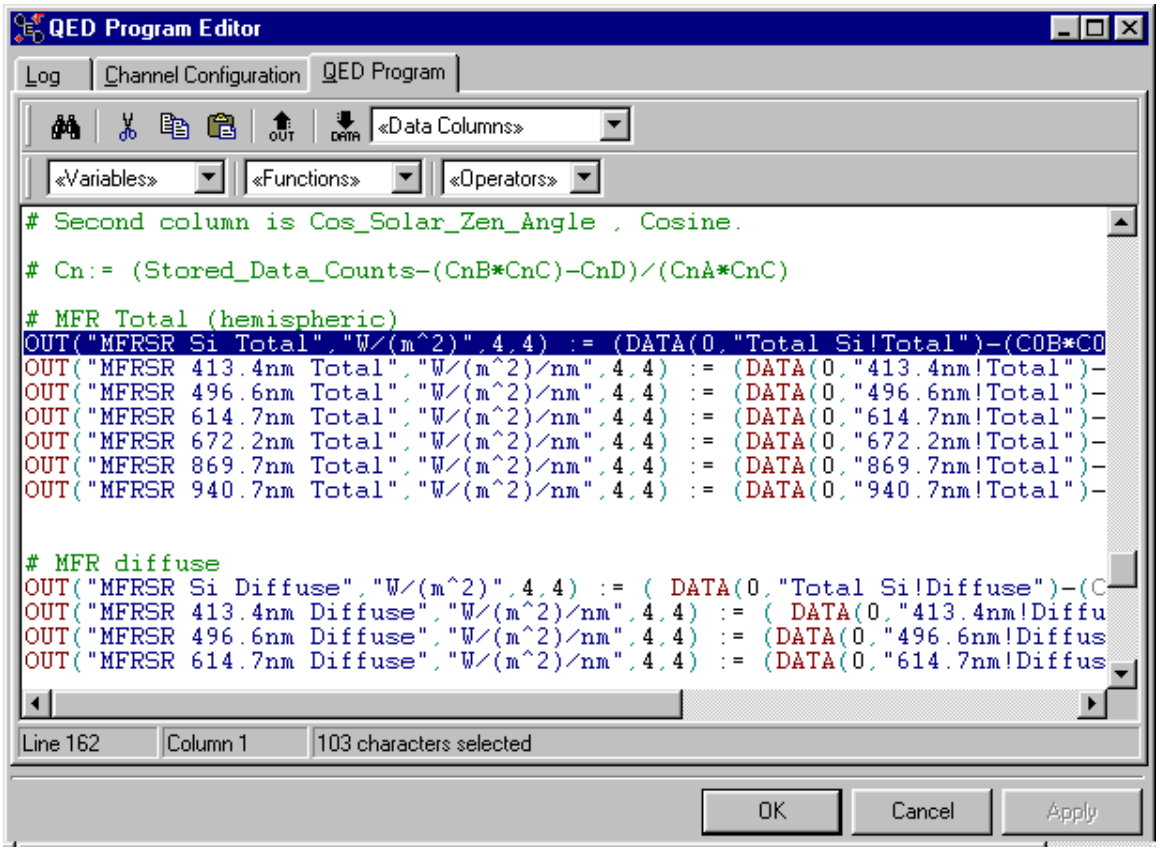


QED program Editor, showing top of file.

While you are editing in the free-form screen editing window, the QED editor has a drop down auto-insertion capability that inserts a valid channel name or function keyword at the current cursor position.

When editing a new QED program to become the **.cal** file for a new profile, note that for your convenience:

- Find, Copy, Cut and Paste icons are on the toolbar,
- Channel names are automatically synchronized with the solar info display names,
- Function keywords are highlighted in red,
- Channel names are in blue,
- User comments are in green,
- Variables are in gray, and
- Constants are in black.



QED program editor view.
Here an output line in a QED program is highlighted to demonstrate the correct syntax for an output statement. Note that for readability purposes, the QED editor auto-inserts channel names taken from the Editor Channel Configuration tab. These names are only shown in the editor view, they are actually converted to column numbers before being written to the final **.cal** file.

Contents of the Solar Information File

The Solar Information file performs several functions: it assigns labels to each channel in a graph, indicates which channels are direct, diffuse or total horizontal and controls the application of angular corrections and Langley processing to direct-normal data columns. YESDAS Manager completely automates the modification of the Solar Information file as you add or delete channels on the YESDAS profile. If you send the instrument back to YES for recalibration, a new Solar Information file is returned with the instrument.
The **.sol** file is a human readable ASCII file that must be in the correct syntax format to prevent errors during processing. The **.sol** file supplied with your YESDAS system may have been

customized for your particular instrument configuration. If you enable or disable instrument channels YESDAS manager will update the **.sol** file to reflect the changes for you automatically. You will find that several different **.sol** files will evolve for use with different sampling protocols you may use. In addition, each time you calibrate an instrument (e.g. the MFR-7 head) the **.sol** file gets updated with a new factory angular correction file. This section explains the format of the **.sol** file and covers each element in the file in detail.

White space ignored

For readability, **.sol** files that YES produces contain spaces to align columns and carriage returns to separate elements in the file. QED treats separators as single spaces regardless of the number and combination of spaces or carriage returns. So, provided the syntax is correct, the form may vary in terms of white space.

Format

The **.sol** file typically contains three main sections, though the third section may be omitted for non-MFR users. The sections *must* appear in the following order:

1 Header

2 Channel description table

3 Angular correction tables (optional for non-MFR users)

The YESDAS Manager profiles permit automated adjustment of the **.sol** file. However, although rare, if a syntax error is found while the **.sol** file is read in and compiled, it will report this. You will need to manually edit the file to satisfy the syntax rules before processing can continue.

Sample .sol file

A sample **.sol** file follows, with the top section called out. For the purposes of this example, the angular response tables have been truncated to save space.

```
MULTIFILTER32 7 35  $28E6  $2A57   35502.00000
LAMBDAS
Total_Si          2       9      16  TABLENL
414.5nm           3      10      17  TABLE
499.5nm           4      11      18  TABLE
613.5nm           5      12      19  KEY TABLE
670.3nm           6      13      20  TABLE
867.6nm           7      14      21  TABLE
936.2nm           8      15      22  TABLENL
MFR_HEAD_TEMP     0      -1      -1  NOLANG
SPUV_TEMP         1      -1      -1  NOLANG
UVB-1            23      -1      -1  NOLANG
TSP-700          24      -1      -1  NOLANG
SPUV_300.3nm     -1      -1      25  NONE
SPUV_312.1nm     -1      -1      26  NONE
SPUV_318.0nm     -1      -1      27  NONE
SPUV_332.5nm     -1      -1      28  NONE
SPUV_368.5nm     -1      -1      29  NONE
SPUV_415.7nm     -1      -1      30  NONE
SPUV_501.5nm     -1      -1      31  NONE
SPUV_616.8nm     -1      -1      32  NONE
SPUV_781.8nm     -1      -1      33  NONE
SPUV_871.1nm     -1      -1      34  NONE
END
SN1
1.95000 0.50544 0.59609 0.66904 0.72993 0.78607 0.83077 0.86919 0.90866 0.94060
0.96885 0.99331 1.00683 1.00844 0.99645 0.98621 0.97644 0.96849 0.96334 0.95238
0.94898 0.94500 0.94119 0.93929 0.93672 0.93533 0.93436 0.93281 0.93358 0.93174
0.93220 0.93357 0.93459 0.93381 0.93531 0.93553 0.93613 0.93731 0.93892 0.93933
0.94153 0.94250 0.94357 0.94510 0.94756 0.94779 0.94867 0.95051 0.95158 0.95352
0.95439 0.95563 0.95732 0.95916 0.95963 0.96176 0.96374 0.96398 0.96508 0.96570
0.96590 0.96677 0.96767 0.96896 0.96926 0.97128 0.97260 0.97413 0.97481 0.97595
0.97560 0.97700 0.97657 0.97769 0.97685 0.97855 0.97912 0.97955 0.97970 0.98132
0.97997 0.97969 0.98112 0.97944 0.97961 0.98085 0.98220 0.98417 0.98926 0.99643
1.00000
0.99442 0.98742 0.98385 0.98154 0.97959 0.97944 0.97796 0.97776 0.97736 0.97791
0.97818 0.97765 0.97727 0.97622 0.97670 0.97586 0.97600 0.97453 0.97451 0.97383
```

Header

Channel description table

```
0.97256 0.97235 0.97216 0.97066 0.96949 0.96885 0.96802 0.96598 0.96492 0.96389
0.96278 0.96190 0.96050 0.95789 0.95787 0.95645 0.95582 0.95418 0.95245 0.95135
0.94901 0.94756 0.94592 0.94414 0.94314 0.94040 0.93809 0.93845 0.93582 0.93475
0.93279 0.93143 0.93043 0.92817 0.92715 0.92677 0.92544 0.92368 0.92277 0.92171
0.92148 0.92194 0.92099 0.92038 0.92240 0.92209 0.92198 0.92445 0.92634 0.92741
0.93115 0.93329 0.93790 0.94284 0.94976 0.95836 0.96270 0.94943 0.92255 0.89279
0.85554 0.81042 0.76785 0.71591 0.65309 0.58978 0.49675 0.37844 0.16427 1.95000
END
.
.
.
up to SN7
WE1
1.95000 0.50822 0.59746 0.66995 0.73060 0.78660 0.83120 0.86955 0.90897 0.94086
0.96908 0.99352 1.00701 1.00861 0.99660 0.98635 0.97657 0.96861 0.96345 0.95248
0.94907 0.94509 0.94128 0.93937 0.93680 0.93540 0.93442 0.93288 0.93364 0.93180
0.93225 0.93362 0.93464 0.93385 0.93536 0.93557 0.93617 0.93735 0.93895 0.93936
0.94156 0.94253 0.94360 0.94513 0.94758 0.94781 0.94869 0.95053 0.95160 0.95354
0.95440 0.95565 0.95734 0.95917 0.95965 0.96177 0.96375 0.96399 0.96509 0.96571
0.96590 0.96678 0.96768 0.96896 0.96926 0.97129 0.97260 0.97414 0.97481 0.97595
0.97560 0.97700 0.97657 0.97769 0.97686 0.97856 0.97912 0.97956 0.97971 0.98133
0.97997 0.97969 0.98113 0.97944 0.97961 0.98085 0.98220 0.98417 0.98926 0.99643
1.00000
0.99442 0.98742 0.98385 0.98154 0.97959 0.97944 0.97796 0.97776 0.97736 0.97791
0.97818 0.97765 0.97727 0.97622 0.97671 0.97586 0.97600 0.97453 0.97452 0.97383
0.97257 0.97235 0.97217 0.97067 0.96950 0.96885 0.96803 0.96599 0.96493 0.96390
0.96279 0.96191 0.96051 0.95790 0.95788 0.95647 0.95583 0.95420 0.95247 0.95136
0.94903 0.94758 0.94594 0.94416 0.94317 0.94042 0.93812 0.93847 0.93585 0.93478
0.93282 0.93147 0.93047 0.92821 0.92719 0.92681 0.92548 0.92373 0.92282 0.92177
0.92154 0.92200 0.92106 0.92045 0.92247 0.92216 0.92206 0.92453 0.92643 0.92751
0.93126 0.93340 0.93802 0.94297 0.94990 0.95852 0.96287 0.94962 0.92276 0.89303
0.85581 0.81073 0.76822 0.71634 0.65362 0.59045 0.49766 0.37982 0.16707 1.95000
END
.
.
.
up to WE7
```

Header of .sol File

The header in a **.sol** file supports several automated quality control functions. It has six elements as shown in the sample below. All elements must accurately describe the corresponding YESDAS system to prevent errors during processing.

Sample header ——— `MULTIFILTER32 7 35  $28D6  $2A47   35502.00000`

ELEMENT	DESCRIPTION
MULTIFILTER32	The type of shadowband instrument supported and number of YESDAS channels. This keyword must appear regardless of whether an MFR is connected to your YESDAS system. Systems manufactured before YES may include other keywords, specific to their versions, (e.g. MULTIFILTER) and you should normally never have to modify this.
7	The number of channels in your shadowband instrument. Typically this value is 7. Specify 4 for a UVMFR-4; specify 1 for an SDR-1. If an MFR, UVMFR, SDR or SDP instrument is not attached to YESDAS, specify 0.
35	The *total* number of *data* columns in the **.xmd** file. Note that a seven-channel MFR instrument produces 21 columns of data because YESDAS provides total, diffuse, and direct

ELEMENT	DESCRIPTION
	readings for each channel. Each auxiliary YESDAS channel produces one data value. In this example, a UVB-1, TSP-700, 10-channel SPUV as well as the MFR head temperature and SPUV temperature are active, resulting in 14 auxiliary channels and a total of 35 data columns including the 21 MFR columns. Notice that the MFR head temperature is monitored separately from the other MFR channels. You must turn on auxiliary channel 0 (either as daytime only or all the time) to log the head temperature.
$28D6	The head ID in HEX of the shadowband instrument attached to YESDAS. If an MFR, UVMFR, or SDR is not connected, the head ID is $0000. The head ID is reported in the YESDAS status message. If an MFR is attached but the ID is $0000, the electronic ID in the head is blown. You can continue processing the files by manually editing the **.sol** file header and changing the ID to $0000 so that it matches the data files collected by YESDAS.
$2A47	The board ID in HEX of the associated YESDAS datalogger.
35502.00000	The spreadsheet date.time in common astronomical format (days *since* January 1, 1900) when the **.sol** file was created. This tells the system the effective "valid from" date of the calibration file and tells the software if the file is too new to belong to the unpacked data file. Note that most spreadsheet programs define this function as January 1, 1900, is day *one*, rather than day *zero* as astronomers and YESDAS do.

The head and board IDs along with the spreadsheet date play a key role in administering data files from large networks of instruments and from instruments that undergo regular calibrations. Each **.xmd** file that you download from a particular YESDAS is tagged with the IDs for the YESDAS board and the shadowband instrument that may be connected. The **.xmd** file also includes the time period over which the data was taken. The IDs prevent you from applying a **.sol** file for one YESDAS to data collected with another. The datestamp prevents you from applying correction factors for one instrument calibration period to data taken during another period. If the IDs in the **.sol** file do not match the IDs in the **.xmd** file, an error occurs. Similarly, if the date in the **.xmd** file is earlier than the date in the **.sol** file, an error also occurs. The **.sol** file is valid for only those **.xmd** files created after the **.sol** file was generated.

Channel Description Table

The second section in a **.sol** file is identified by the keyword LAMBDAS. It consists of a table that describes each YESDAS channel that the **.sol** file will be applied to. The LAMBDAS table provides channel labels for the Day Plot function as well as keywords for angular correction and Langley analysis. The table must have at least as many entries as the number of active shadowband channels since angular correction tables will always exist for these channels. You should insert descriptions for other channels that you want to plot or run automated Langley regressions on.

Adding channel descriptions

In the example below, the following instruments are connected to YESDAS: MFR-7, UVB-1, TSP-700, and a SPUV-10. The MFR-7 produces 21 columns of data, the TSP-700 and UVB-1 each produce one column of data, and the SPUV-10 adds ten more columns. The temperature of the MFR head and SPUV instrument are also being monitored. Notice that the auxiliary channel entries were added after the shadowband channel entries. The angular correction tables expect

the shadowband channels to appear first in the LAMBDAS table. Each angular correction table refers to the *line* in LAMBDAS containing the corresponding channel entry. Although you could insert entries before the shadowband channels and then change the line references in the angular correction tables, it's safer to add new entries to the end of the LAMBDAS table and avoid editing the angular correction tables.

The auxiliary channel descriptions can appear in any order, but they must reference the correct data column in the **.xmd** file. For readability and ease of maintenance, you may prefer to organize them in ascending data column order. (The order of data columns in an **.xmd** file is described below.) The sample LAMBDAS table below is organized in data column order except for the all-the-time auxiliary channels, which precede the MFR data in the **.xmd** file but are listed after MFR channels because the angular correction tables expect MFR channel descriptions to appear on lines 1 through 7.

```
LAMBDAS
Total_Si          2       9      16  TABLENL
414.5nm           3      10      17  TABLE
499.5nm           4      11      18  TABLE
613.5nm           5      12      19  KEY TABLE
670.3nm           6      13      20  TABLE
867.6nm           7      14      21  TABLE
936.2nm           8      15      22  TABLENL
MFR_HEAD_TEMP     0      -1      -1  NOLANG
SPUV_TEMP         1      -1      -1  NOLANG
UVB-1            23      -1      -1  NOLANG
TSP-700          24      -1      -1  NOLANG
SPUV_300.3nm     -1      -1      25  NONE
SPUV_312.1nm     -1      -1      26  NONE
SPUV_318.0nm     -1      -1      27  NONE
SPUV_332.5nm     -1      -1      28  NONE
SPUV_368.5nm     -1      -1      29  NONE
SPUV_415.7nm     -1      -1      30  NONE
SPUV_501.5nm     -1      -1      31  NONE
SPUV_616.8nm     -1      -1      32  NONE
SPUV_781.8nm     -1      -1      33  NONE
SPUV_871.1nm     -1      -1      34  NONE
END
```

Each channel description includes the following information:

- Name
- Column position in the **.xmd** file and type of data
- Keyword for angular correction and Langley analysis

Name

Description of the channel, which appears in the day plot header. Names can contain up to 32 characters. Underscores are converted to spaces.

Column position and type of data

The next three fields in each channel description indicate the *position* (not the YESDAS channel) of the data in an unpacked **.xmd** file and whether the data in that position is total-horizontal, diffuse-horizontal, or direct-normal, respectively. These labels appear in the legend on day plots. For instruments that produce only one value per channel, you need only specify a value for one field out of the three; the unused fields in that row should be set to -1. In the example above, the UVB-1 and TSP-700 measure *total-horizontal* UVB and *total-horizontal* visible irradiance, respectively, so the first column is filled in for these instruments. The head temperature and SPUV instrument temperature also produce total data. For the SPUV channels, the direct-normal column (third column) is used.

In order to specify the correct column position of data in the input **.xmd** file, you must know the order of data columns in a YESDAS record. When specifying the column position in the **.sol** file, the first data column is column 0. (Note that in the **.cal** file the first data column is 1). The organization of data columns reflects the order in which channels are sampled:

1 Counters in ascending channel order.

2 All-the-time channels (ALLAUX) channels in ascending channel order.

3 Shadowband instrument channels 1 through 7. Total irradiances for all channels appear first, followed by diffuse for all channels, and then direct. Note that the MFR head temperature is monitored on channel 0, which is enabled as an all-the-time or daytime channel; so it either precedes MFR data columns or follows them. In the sample LAMBDAS table, the head temperature is logged all the time.

4 Daytime only (DAYAUX) channels in ascending channel order.

In the LAMBDAS table above, the MFR head temperature and SPUV instrument temperature are monitored all the time and, therefore, appear first in the **.xmd** file. The MFR channels are sampled after the ALLAUX channels. The UVB-1, TSP-700, and SPUV channels are monitored during the daytime only and appear last in the **.xmd** file, after the shadowband data. If you were to connect a wind sensor to one of the digital counters, you would then increment the column positions for all channels in the LAMBDAS table since the counter data would appear first (in data column 0) in the **.xmd** file.

Keyword for angular correction and Langley analysis

The last field in the channel description table tells the host software whether angular correction tables are included for this channel and whether the channel should be considered by the automated Langley analysis function. Valid keywords are

- **NONE**. Apply no angular correction. Specify NONE if no angular correction tables exist for the instrument. You can still perform automated Langley analysis on the channel's data provided the instrument connected to that channel produces direct-normal data at desirable wavelengths. For example, you would specify NONE for SPUV instrument channels because no angular correction is necessary for the direct-normal data but the data is suitable for Langley analysis.
- **NOLANG**. Apply no angular correction and do *not* consider for Langley analysis. Select this option for instruments that produce total irradiance, such as the UVB-1 and TSP-700. Data from these instruments cannot be angular corrected because, unlike a shadowband instrument, the direction of the incoming photons is not known. The NOLANG keyword should also be used for other instruments that produce total-type readings such as counters and temperature monitors.
- **TABLE**. Apply angular correction factors from the supplied tables.
- **TABLENL**. Apply angular correction factors from the supplied tables, but do not consider the channel for Langley analysis.
- **VOIDTBL**. Similar to NOLANG except that a angular correction table may exist for the channel, but you do not want to use the table at this time.

In the earlier example, the 613.5 nm MFR-7 channel is designated as the key channel as denoted by the word KEY before the angular correction keyword.

Harrison Objective algorithm

The simple-minded notion of using a least-squares regression on *all* the data only works under perfect sky conditions -- e.g. Mauna Loa on a good day. Elsewhere cloud transients, even thin cirrus clouds, will produce "dips" in the profile that must be removed or the regression will produce nonsense results. In the past this was done by subjective editing; the scientist examines the data graphically and determines which points should be used for the regression. Aside from being quite labor intensive this process is subject to criticism that differing analysts may arrive at different results, and that often analysts cannot give useful descriptions of what "algorithm" they use to decide which points should be kept, and which rejected.

The Harrison Objective algorithm operates on the data with a series of filters to remove erring measurements. The first filter is a delta-difference derivative filter that identifies regions where the slope of dI/d(Airmass) is positive. These cannot be produced by any uniform air-mass turbidity process, and are evidence of the "recovery" of the intensity from a cloud passage. The algorithm then "folds back" to find the point where the cloud passage started. A second derivative filter follows to "clean-up" points on the boundaries created by the first. On rare occasions (one out of 230 examples tested) this filter will be too aggressive and discard so many points that a Langley event is lost that otherwise is acceptable. It is possible to turn this off when doing Langley regressions from the Solar Plot window by using the options dialog. The entire

region is then eliminated; these data points will be identified in the plot with a small box as the plotting symbol.

Two iterations are then made of a robust linear regression. After each iteration the points that lie more than 1.5 standard deviations from the regression are removed. The automated algorithms (either multi-file or active file) will only report data where the number of kept points is greater than five, and greater than 0.3 times the number of points available. In addition the standard deviation of the residuals of ln(I) around the regression must be less than 0.0060—these criteria have been established by extensive test as useful guides to throwing out erring or suspicious events.

The key wavelength channel

One channel in the LAMBDAS section of the **.sol** file can be identified as the key channel. The Harrison Objective algorithm processes the key channel first when it filters and selects data points for Langley analysis. The selected data set is then applied to other channels. This speeds up the process by more than a factor of three by reducing the computations required for the other wavelengths. It also ensures that all of the regressions are *almost* identical with respect to the chosen points. Because the key data set may have independently erring points, a filter is applied after the key mask to remove points that lie beyond two standard deviations of the regression.

Selecting the key channel

In general you should select a key channel with low noise and at least moderate optical depth. Channels near the maximum of the solar spectrum (around 530 nm) are best. For an MFR or SPUV, either the 500 or 615 nm channel is a good choice. If a key channel has been identified then the results for all channels will be computed and reported if the key channel meets the criteria discussed above.

Angular Correction Tables

If a shadowband instrument (SDR, MFR, or UVMFR) is connected to your YESDAS system, your **.sol** file will include angular correction tables for each channel. These tables are automatically generated when the instrument head undergoes cosine calibration. Two tables are generated for each shadowband channel: one for the scan from the south horizon to the north horizon (denoted by SN), the other for the west horizon to the east horizon scan (denoted by WE). Tables generated by YES appear in ascending channel order with all SN tables listed first; however, they could appear in any order, i.e., channels may be out of sequence or WE tables could precede SN tables. A unique number is appended to each orientation code, indicating the line of the corresponding channel entry in the LAMBDAS table. In the example below, SN1 and WE1 refer to the Total_Si channel; SN2 and WE2 refer to the 414.5nm channel, and so on. You should always add new entries after the shadowband entries in the LAMBDAS table so that line references in the correction tables are correct.

Each table must have 181 numbers describing the correction factors at 1° intervals. The center element of the table is the zenith and should be 1.0 by the standard normalization criterion, and must match the center element of the corresponding table in the orthogonal axis. Each value represents the measured response at that angle and is used as a dividing factor during the corrections. The values can range from near 0 to 2.0 - 1/65536. This range is sensible in that no useful instrument should have corrections lying outside this range, and it permits the actual arithmetic to be done using integers (a substantial speed advantage.) The keyword END marks the completion of a table.

Warning: The 14 angular correction tables supplied with your shadowband radiometer are based on precise laboratory characterizations and are system-specific. You should never modify or otherwise process them.

Abbreviated angular correction tables for a seven-channel MFR follow.

```
SN1
1.95000 0.50544 0.59609 0.66904 0.72993 0.78607 0.83077 0.86919 0.90866 0.94060
0.96885 0.99331 1.00683 1.00844 0.99645 0.98621 0.97644 0.96849 0.96334 0.95238
0.94898 0.94500 0.94119 0.93929 0.93672 0.93533 0.93436 0.93281 0.93358 0.93174
0.93220 0.93357 0.93459 0.93381 0.93531 0.93553 0.93613 0.93731 0.93892 0.93933
0.94153 0.94250 0.94357 0.94510 0.94756 0.94779 0.94867 0.95051 0.95158 0.95352
0.95439 0.95563 0.95732 0.95916 0.95963 0.96176 0.96374 0.96398 0.96508 0.96570
0.96590 0.96677 0.96767 0.96896 0.96926 0.97128 0.97260 0.97413 0.97481 0.97595
0.97560 0.97700 0.97657 0.97769 0.97685 0.97855 0.97912 0.97955 0.97970 0.98132
0.97997 0.97969 0.98112 0.97944 0.97961 0.98085 0.98220 0.98417 0.98926 0.99643
1.00000
0.99442 0.98742 0.98385 0.98154 0.97959 0.97944 0.97796 0.97776 0.97736 0.97791
0.97818 0.97765 0.97727 0.97622 0.97670 0.97586 0.97600 0.97453 0.97451 0.97383
0.97256 0.97235 0.97216 0.97066 0.96949 0.96885 0.96802 0.96598 0.96492 0.96389
0.96278 0.96190 0.96050 0.95789 0.95787 0.95645 0.95582 0.95418 0.95245 0.95135
0.94901 0.94756 0.94592 0.94414 0.94314 0.94040 0.93809 0.93845 0.93582 0.93475
0.93279 0.93143 0.93043 0.92817 0.92715 0.92677 0.92544 0.92368 0.92277 0.92171
0.92148 0.92194 0.92099 0.92038 0.92240 0.92209 0.92198 0.92445 0.92634 0.92741
0.93115 0.93329 0.93790 0.94284 0.94976 0.95836 0.96270 0.94943 0.92255 0.89279
0.85554 0.81042 0.76785 0.71591 0.65309 0.58978 0.49675 0.37844 0.16427 1.95000
END
SN2
1.95000 1.08035 0.73142 0.77971 0.82887 0.85440 0.87637 0.88917 0.96295 0.97844
1.01079 1.03368 1.03521 1.03892 1.02251 1.00731 0.98486 0.97179 0.96745 0.95418
0.95719 0.95625 0.94842 0.95091 0.95087 0.95058 0.94751 0.94066 0.94294 0.93718
0.93613 0.93853 0.94347 0.93800 0.94129 0.94338 0.94382 0.94486 0.94773 0.94937
0.94950 0.94637 0.94972 0.94624 0.94900 0.95009 0.95188 0.95699 0.95709 0.95905
0.96043 0.96163 0.95954 0.96084 0.96084 0.96338 0.96817 0.96554 0.96824 0.97120
0.97424 0.97304 0.97320 0.97265 0.97171 0.97484 0.97638 0.97759 0.97881 0.97802
0.98110 0.98350 0.98118 0.98239 0.98263 0.98601 0.98553 0.98094 0.98353 0.98417
0.98176 0.98342 0.98634 0.98797 0.98374 0.98577 0.98638 0.98621 0.99029 0.99653
1.00000
0.99586 0.98890 0.98680 0.98537 0.98300 0.98395 0.98232 0.98187 0.98003 0.98159
0.97906 0.97989 0.98346 0.98185 0.98066 0.98157 0.98274 0.98140 0.97676 0.97724
0.97381 0.97343 0.97577 0.97379 0.97501 0.97760 0.97361 0.96972 0.96859 0.97114
0.96359 0.96190 0.96272 0.95928 0.96180 0.95999 0.96284 0.95851 0.95728 0.95493
0.95223 0.94747 0.94850 0.94486 0.94598 0.94393 0.94198 0.94177 0.94327 0.93986
0.93665 0.93519 0.93340 0.93120 0.93275 0.93200 0.93267 0.92947 0.93415 0.93197
0.93437 0.93103 0.92450 0.92841 0.92897 0.93111 0.93542 0.94126 0.94637 0.94734
0.94715 0.95070 0.95337 0.95581 0.96496 0.97983 0.99592 0.98533 0.95951 0.93908
0.91782 0.86639 0.82583 0.77683 0.72901 0.60321 0.61460 0.59761 0.61435 1.95000
END
```

. . . up to SN7

```
WE1
1.95000 0.50822 0.59746 0.66995 0.73060 0.78660 0.83120 0.86955 0.90897 0.94086
0.96908 0.99352 1.00701 1.00861 0.99660 0.98635 0.97657 0.96861 0.96345 0.95248
0.94907 0.94509 0.94128 0.93937 0.93680 0.93540 0.93442 0.93288 0.93364 0.93180
0.93225 0.93362 0.93464 0.93385 0.93536 0.93557 0.93617 0.93735 0.93895 0.93936
0.94156 0.94253 0.94360 0.94513 0.94758 0.94781 0.94869 0.95053 0.95160 0.95354
0.95440 0.95565 0.95734 0.95917 0.95965 0.96177 0.96375 0.96399 0.96509 0.96571
0.96590 0.96678 0.96768 0.96896 0.96926 0.97129 0.97260 0.97414 0.97481 0.97595
0.97560 0.97700 0.97657 0.97769 0.97686 0.97856 0.97912 0.97956 0.97971 0.98133
0.97997 0.97969 0.98113 0.97944 0.97961 0.98085 0.98220 0.98417 0.98926 0.99643
1.00000
0.99442 0.98742 0.98385 0.98154 0.97959 0.97944 0.97796 0.97776 0.97736 0.97791
0.97818 0.97765 0.97727 0.97622 0.97671 0.97586 0.97600 0.97453 0.97452 0.97383
0.97257 0.97235 0.97217 0.97067 0.96950 0.96885 0.96803 0.96599 0.96493 0.96390
0.96279 0.96191 0.96051 0.95790 0.95788 0.95647 0.95583 0.95420 0.95247 0.95136
0.94903 0.94758 0.94594 0.94416 0.94317 0.94042 0.93812 0.93847 0.93585 0.93478
0.93282 0.93147 0.93047 0.92821 0.92719 0.92681 0.92548 0.92373 0.92282 0.92177
0.92154 0.92200 0.92106 0.92045 0.92247 0.92216 0.92206 0.92453 0.92643 0.92751
0.93126 0.93340 0.93802 0.94297 0.94990 0.95852 0.96287 0.94962 0.92276 0.89303
0.85581 0.81073 0.76822 0.71634 0.65362 0.59045 0.49766 0.37982 0.16707 1.95000
END
```

```
WE2
1.95000 0.99091 0.68700 0.75055 0.80738 0.83751 0.86254 0.87753 0.95305 0.96983
1.00324 1.02699 1.02921 1.03350 1.01756 1.00276 0.98065 0.96789 0.96384 0.95081
0.95406 0.95333 0.94568 0.94835 0.94847 0.94833 0.94539 0.93865 0.94105 0.93539
0.93444 0.93693 0.94196 0.93657 0.93994 0.94211 0.94261 0.94372 0.94665 0.94835
0.94853 0.94545 0.94885 0.94541 0.94822 0.94935 0.95119 0.95634 0.95647 0.95847
0.95988 0.96111 0.95905 0.96037 0.96040 0.96297 0.96780 0.96518 0.96790 0.97089
0.97395 0.97277 0.97294 0.97241 0.97149 0.97463 0.97620 0.97742 0.97865 0.97788
0.98096 0.98338 0.98107 0.98229 0.98254 0.98593 0.98546 0.98086 0.98347 0.98411
0.98171 0.98337 0.98631 0.98794 0.98370 0.98574 0.98635 0.98619 0.99028 0.99652
1.00000
0.99586 0.98888 0.98678 0.98535 0.98296 0.98391 0.98228 0.98182 0.97998 0.98153
0.97899 0.97982 0.98339 0.98177 0.98058 0.98148 0.98264 0.98129 0.97664 0.97710
0.97365 0.97326 0.97559 0.97360 0.97481 0.97738 0.97337 0.96946 0.96831 0.97084
0.96326 0.96156 0.96235 0.95889 0.96139 0.95955 0.96238 0.95802 0.95675 0.95438
0.95164 0.94683 0.94783 0.94415 0.94523 0.94314 0.94114 0.94089 0.94234 0.93888
0.93561 0.93409 0.93224 0.92997 0.93146 0.93063 0.93123 0.92794 0.93254 0.93027
0.93257 0.92912 0.92246 0.92626 0.92668 0.92868 0.93284 0.93851 0.94343 0.94420
0.94377 0.94706 0.94945 0.95156 0.96035 0.97481 0.99043 0.97924 0.95270 0.93141
0.90911 0.85634 0.81409 0.76285 0.71192 0.58136 0.58518 0.55297 0.52417 1.95000
END
```

. . . up to WE7

Contents of the Calibration Information File

This section describes the structure of the **.cal** file as well as the format of statements in the file. Like other programming languages, the language used to process YESDAS data, referred to as QED, is stored in the **.cal** file. QED supports common structures such as variables and arithmetic operators.

Origin of QED Language

QED is a compiled data processing language that was designed to handle run time exceptions (e.g. divide by zero) when processing large streams of data. It was initially developed by Dr. Lee Harrison of the State University of New York at Albany. YES has licensed this software from Dr. Harrison, who continues to maintain and support it.

White space, comments, and separators

Like many compiled languages the QED parser treats any sequence of spaces, carriage returns, or other control characters as a single space. You can use as much white space as needed to make the **.cal** file readable.

Comments are denoted by the pound sign (#). In general, you should precede comments with a white space interval to ensure that the comment will be interpreted separately from an operator or variable name. As with other programming languages, comments aid readability of your code. QED reports an unknown variable or unknown operator error if it cannot recognize a comment. All characters after the pound sign are ignored, up to the first occurrence of a carriage return, which signals the end of the comment. (The ability to end a comment is the only lexically unique property of a carriage return.)

Like C and PASCAL the semicolon (;) is used to separate logical statements. The semicolon need not be preceded by white space.

Organization

The **.cal** file is organized as follows:

1 Header

2 PRODUCES section

3 DECLARE section

4 Variable initialization section

5 REPEAT section

Sample .cal file

A sample **.cal** file follows, with the main sections called out.

Header of the .cal File

The header in a **.cal** file has seven elements as shown in the example below. All elements must match the corresponding YESDAS system to prevent errors during processing. The first six elements are identical to the associated **.sol** file header.

Sample header

```
MULTIFILTER32  7  35  $28D6  $2A47  35502.00000  NONSTANDARD
```

ELEMENT	DESCRIPTION
MULTIFILTER32	The type of shadowband instrument supported and number of YESDAS channels. This keyword must appear regardless of whether an MFR is connected to your YESDAS system.
7	The number of channels in your shadowband instrument. Typically this value is 7. Specify 4 for a UVMFR-4; specify 1 for an SDR-1. If an MFR, UVMFR, or SDR is not attached to YESDAS, specify 0.
35	The *total* number of *data* columns in the **.xmd** file. Note that a seven-channel MFR instrument produces 21 columns of data because YESDAS provides total, diffuse, and direct readings for each channel. Each auxiliary YESDAS channel produces one data value. In this example, a UVB-1, TSP-700, 10-channel SPUV as well as the MFR head temperature and SPUV temperature are active, resulting in 14 auxiliary channels and a total of 35 data columns including the 21 MFR columns. Notice that the MFR head temperature is monitored separately from the other MFR channels. You must turn on auxiliary channel 0 (either as daytime only or all-the-time) to log the head temperature.
$2A47	The head ID in HEX of the shadowband instrument attached to YESDAS. If an MFR, UVMFR, or SDR is not connected, the head ID is $0000. The head ID is reported in the YESDAS status message. If an MFR is attached but the ID is $0000, the electronic ID in the head is blown. You can continue processing the files by manually editing the **.cal** file header and changing the ID to $0000 so that it matches the data files collected by YESDAS.
$28D6	The board ID in HEX of the associated YESDAS datalogger.
35502.00000	The spreadsheet date.time (days since January 1, 1900) when the **.cal** file was created.
STANDARD	The type of **.cal** file. If the **.cal** file produces exactly one output column for each input column, it is a STANDARD **.cal** file. If it processes a subset of the input columns or produces more output columns than input columns, it is NONSTANDARD.

PRODUCES Section

The PRODUCES section contains heading labels (a name and the physical units) for each column in the calibrated output file. One statement must exist for each column of output (as defined by the OUT or IOUT statements in the REPEAT section). The order of the statements in

the PRODUCES section must match the order of the statements in the REPEAT section so that output is labeled correctly. The PRODUCES statements are in the form

```
name, unit;
```

where *name* and *unit* can each contain up to 20 alphanumeric characters. Underscore characters (_) are converted to spaces in the output file. However, you should take care when using the underscore since many programs do not import spaces in names. The name and unit are separated by a comma (,) and the end of a statement is indicated by a semicolon (;).
The pound sign (#) normally signifies a comment. Although they can be used in names or units this is not good programming practice. Comments are not allowed in the PRODUCES section. The keyword END must appear after the last statement in the PRODUCES section.

DECLARE Section

The DECLARE section lists any variables used in the **.cal** file. If no variables are used, this section can be omitted. Variable names are separated by commas and may appear on the same line or on multiple lines. A semicolon (;) appears at the end of the variable declarations. Comments may appear in the DECLARE section but not where a comma or semicolon is expected. The following example shows two equivalent variable declarations:

```
DECLARE C1A, #Sensitivity for first channel in MFR head
         C1B; #Offset for first channel in MFR head

DECLARE C1A, C1B;
```

Variable names must obey the following rules:

- Names must be begin with an alphabetic character; remaining characters may contain numbers or the underscore (_) character.
- Names are case sensitive; the variable *a1* is different from *A1*.
- During **.cal** file evaluation, only the first four characters of the variable name are considered, though names can contain more than four characters for documentation purposes. So, for example, the variable *AAAA* is different from *AAA*; however, *AAAA* is the same as *AAAAA* and *AAAAB*.

Arrays

Typically you will use simple variables like those above, but array variables are also supported. Array variables may have one to three dimensions. For any dimension, the index ranges from 0 to the maximum value specified in the array declaration. The indexes of the array are declared and referenced in calculations within brackets ([ ]). Note that comments may not appear within brackets. Index usage is checked at runtime, and errors will halt execution with an error message. The following sample statement declares two array variables:

```
DECLARE oneD[100], twoD[9,19];
```

where *oneD* is a vector of 101 elements, ranging from 0 to 100 and *twoD* is a two-dimensional array of 10 x 20 elements.

Variable Initialization Section

Immediately following the DECLARE statement, you can perform initialization operations as needed. Typically these are used to define values that will be used throughout the REPEAT section. You can define constants, initialize variables, fill arrays, and so on. The **.cal** files produced by YES contain variable declarations and initializations for the calibration factors for any instruments connected to YESDAS as well as for the YESDAS channels themselves. Calibration constants are always assigned numerical values.

REPEAT Section

The REPEAT section contains calculations as well as the statements to write out and format the processed data. The REPEAT section is executed once sequentially from top to bottom for each row of input. You use the DATA, OUT or IOUT functions to read and write columns from the input file. The DATA function reads in a specified row and column from the input **.xmd** file.

The OUT and IOUT functions write real and integer data, respectively, in the specified format. In the following example, the data in the first column of the input data set is written out as a real with four digits to the left and three to the right of the decimal point.
Note that the DATA function references a *data column* in the input data record; it does not

```
OUT(4,3) := (DATA(0,1)-(C0B*C0C)-C0D)/(C0A*C0C); # in W/m^2
```

Operates on the current row (this permits convolution algorithms)

Processes the data in column 1 of the input data file

Formula to convert to W/m^2 and compensate for head and board offsets and sensitivities

reference a channel number.
Data are written to the output file in order as one-line-in-the-output per time-step-in-the-input-data; the software does all of these instructions in this section once per time step, and handles all I/O and formatting.

DATA function

The DATA function reads in a specified record from the data stream. A record can be thought of as one time step through all enabled channels. It is always used in the form:

```
DATA(Row_Offset,Data_Column)
```

Where *Row_Offset* is the time step forward or backward in time from the current record (zero indicates the data is taken from the current record). This permits local convolution and averaging of adjacent data records. *Data_Column* is the column offset from the first data column. Note that the spreadsheet date/time and cosine_of_zenith_angle (CZA) columns are not counted, so the first data column is actually the third output file column, after the time and CZA. QED sweeps through the data by row, from top to bottom. For each row the QED program is executed once. The Row_Offset is zero to reference the row being currently operated upon by QED. Negative values reference previous rows, and positive values reference those not reached yet. It is permissible to reference a row that is outside the range of the data; in this case the value 0 is always returned. This is done so that convolution or other time-domain filters need not have special start-up and termination conditions.
Important: The *Data_Column* references any column from 1 to the maximum number of columns in the data. Note that the date/time and solar zenith angle are not counted, so the first data column actually is printed out after these as column three. If a column value outside this valid range is passed then the program will halt with a run-time error message. Note that input data can have "flag values" that indicate that a particular datum is not a valid number. If a datum is invalid then this property is carried through subsequent computation — see " Run Time Processing Error Codes", later in this section.
The REPEAT section is executed once sequentially from top to bottom for each row of input. These are the calculations that do your desired data transformations, and output is written using the special functions OUT and IOUT discussed next.
In the REPEAT section the number of calls to the left-hand functions "OUT(X,Y)" (which prints a real number with X digits to the left of the decimal place, and Y digits to the right,) or "IOUT(Z)" (prints an integer of Z digits,) must match the number of names defined in the PRODUCE statements above it.

Controlling Output Formatting

QED has two special functions OUT and IOUT: these write real and integer outputs respectively. Special restrictions apply to the use of these functions:

- They may only appear *on the left-hand side* of assignment statements
- The may only appear in the REPEAT section of the QED program: they are illegal in the initialization section
- The total number of OUT and IOUT occurrences must match the number of names defined in the PRODUCES statement

Violations of these rules are detected before run-time, and halt execution with an error message. These functions specify an output and its formatting when the output is to an ASCII file, the normal usage of QED. (The formatting is not obeyed when the output is to a binary file; in this case the output is simply written in the chosen binary real-number format. For this purpose

OUT and IOUT are identical except that IOUT automatically rounds the value to an integer.)
To summarize:

- OUT(nleft,nright) produces a “real” number with nleft digits to the left of the decimal point, and nright to the right.
- IOUT (nleft) produces an integer (by rounding the assigned value) with nleft digits.

The nleft digit space should include room for a minus sign; positive numbers do not have a preceding "+" symbol. Note that in both cases if the number is larger than can be expressed in nleft digits then the output will produce the number of digits needed to correctly represent the result.
If fewer digits are needed then the output will be left-padded with spaces to make up the appropriate length *only if* the fixed-column option is selected. In general this option *should not* be used because doing so substantially increases the size of your output file. It is needed only if the output data are to be subsequently used by programs with older inflexible data formatting, (such as early-generation FORTRAN "read" statements.)
The occurrences of OUT or IOUT from top to bottom in the QED program produce the columns of the output data from left to right. This is the reason that the number of OUT and IOUT must match the number of names, and that these functions can only appear in the REPEAT section. These restrictions guarantee that the number of names will match the number of columns produced, and that there will be one row of output for each row of input. However, if you specify NONSTANDARD in the header, the number of input and output columns can differ.
The output columns are separated by the Tab character independent of the formatting specified by OUT and IOUT, unless you change the separator in the Data Manger options. The rows are separated by the Newline character. For most applications, including spreadsheets such as IBM Lotus 123® and MS-Excel® the Tab character should be a Tab (ASCII value = 9) and the Newline character should be a Carriage-Return on the Unix or Macintosh (ASCII value = 13) or CR/LF on the PC.

Performing Calculations

All the standard functions you would expect on a very powerful calculator are available in QED.

Numbers

The exact syntactic specification of the ASCII representations of numbers in your QED program will be implementation specific due to features of ASCII to real-number conversion functions supported in system libraries. However you will always be able to do the following:

- *Integers* with an optional leading minus sign, and up to 12 digits long
- *Reals* with an optional leading minus sign, and up to 12 digits total, both to the left and right side of decimal point
- *Scientific numbers* consisting of a valid real, followed by "E" or "e" and then an exponent ranging from [-30..30]

Some examples of valid numbers are:

```
123456789, 123456789.123,  123456789.123E-23
```

All numbers are immediately converted to 64-bit floating-point representations by the QED parser, and used in this from thereafter.

Assignment statements

Algebraic assignment statements in QED are written using Cambridge Infix Notation, where operations within parentheses are performed first and multiplication has precedence over addition and so on. The assignment operator is a colon followed by the equal sign (:=) as in PASCAL. Each assignment statement may have only one assignment operator and must end with a semicolon. The following are valid assignment statements:

```
A := 1;     # assign the value 1.0 to the variable A;
A := (PI + b)/(C - 2.3E-1); # Here the variables PI, b and C are used
A := SIN(z); # assign the value of the sine of z to A
A := ARRAY[z] # if z is out-of-index-range this causes a run-time halt!
ARRAY[z] := ARRAY[ln(z)] ;    # if ln(z) is out-of-index it run-time halts!
```

The QED parser is fully recursive, and no limits exist on expression nesting. Note also that QED has only one basic variable type: 64-bit reals. Any time a value must be intrinsically used as an integer, for instance, when it is used as an index, the integer value is the *rounded* value of the real.

QED supports the unary negative: the first variable or constant occurring at a given nesting level can be preceded by a negative sign, i.e. all of the following are valid expressions:

```
-1    # a unary negative constant
-A    # unary negative variable
-(-A))# nested unary negative expression (legal, but of course
useless)
```

However, expressions such as a + -b are detected as an operator error. QED has the following standard dyadic operators (dyadic operators operate on two numbers to produce one) with the following precedence levels:

SYMBOL	OPERATION	PRECEDENCE LEVEL
^	to the power of	1 (highest)
MOD , FMOD	modulo, remainder	1
* , /	multiplication, division	2
+ , -	addition, subtraction	3 (lowest)

Thus the expression 1+2/9^0.5 is equal to 1 + (2/(9^0.5)) and evaluates to 1.666666....
The MOD operator returns the integer remainder of the equivalent *integer* division. *This remainder is always positive.* Normally you apply this function only to values that are presumed to be integers; though it is unambiguously defined for any real number. In terms of the other defined functions the MOD operator can be written (the functions ABS, RND, SIGN, and TRUN are defined below).
a MOD b is equivalent to
ABS(RND(a)) - ABS(TRUN(RND(a)/RND(b)) * ABS(RND(b))
The FMOD operator returns a "fractional remainder:" the remainder left after the maximum of number *integer* multiples of b have been added/subtracted from a. *This remainder always has the same sign that the division would have had.* In terms of the other defined functions the FMOD operator can be written
a FMOD b is equivalent to
SIGN(a*b) *(ABS(a) - TRUN(ABS(RND(a)/RND(b)))*ABS(b))
Obviously it's much easier to write and use these functions only when you need them.

QED Standard Functions

In addition to the dyadic operators QED supports the following standard algebraic functions:

SYMBOL	OPERATION	PRECEDENCE LEVEL
LN	natural logarithm	1
EXP	e to the power of	1
SIN	Trigonometric Sine	1
COS	Trigonometric Cosine	1
TAN	Trigonometric Tangent	1
ASIN	Trigonometric ArcSine	1
ACOS	Trigonometric ArcCosine	1
ATAN	Trigonometric ArcTangent	1
ABS	Absolute value	1
RND	Round to integer	1
TRUN	Truncate to integer	1
SIGN	+1 if >= 0, -1 otherwise	1

MAX	Returns the greater of the two	2
MIN	Returns the lesser of the two	2
CIRC	see below	2
POLE	see below	2
MAG	see below	2
DATA	see below	2

The standard algebraic functions can only appear on the right-hand side of an assignment statement; it is not possible to assign a value *to* a function name. QED checks the names of variables in the DECLARE statement to prevent any variable from having the same name as a function.

Note that all of the trigonometric functions expect/return a value in radians. The functions ATAN, ASIN, ACOS obey the standard definitions for the principle branch respectively: ATAN and ASIN return a value in the range $-\pi/2$ to $+\pi/2$, ACOS returns a value in the range 0 to π.

Users should note that if you need constant values for the transcendental numbers "e" and "PI" that these should be created by the evaluation of the corresponding function, rather than supplied as a literal constant; doing so produces a value to the full accuracy of machine precision (independent of platform,) and self-consistent with the approximations used. This is good programming practice in any language. For example

```
DECLARE e, PI;
e := EXP(1);
PI := 4*ATAN(1);
```

The CIRC function returns an angle in radians given two orthogonal coordinates. CIRC(x,y) returns an angle

$-\pi < \text{CIRC}(x,y) <= \pi$

where the angle is referenced to the x axis, and is positive counterclockwise.

The POLE function returns an angle in degrees given two orthogonal coordinates. POLE(north,east) returns an angle 0 <= POLE(north,east) < 360 where the angle is referenced to the north axis, and is positive clockwise.

The MAG function returns the Euclidean magnitude (i.e. MAG(x,y) = (x^2 + y^2)^0.5); it is provided simply for expression efficiency.

Run Time Processing Error Codes

Like most compiled languages there are two sets of QED errors that will be detected: compile-time and run-time. Syntactic errors caught at compile-time produce error messages and prevent application of the erring **.cal** file to any data. Localized run-time errors (i.e. divide-by-zero) are caught and produce flagged outputs with a representative "not a number" expression. In addition there are a set of fatal runtime errors (e.g. array-index out of range, output overflow, etc.) that halt computation when detected, and produce error messages.

QED handles run-time numeric exceptions in a way that is designed to permit the computation to proceed even though some data and or transformations produce numeric exceptions. These exceptions are flagged and carried through the computation: every affected output is correspondingly tagged.

This flow-of-error tracking is done by a mechanism that is independent of not-a-number specifications for the computational platform, and so is machine and implementation independent. (This mechanism does not keep track of errors that are due to numeric under-flow or overflow of results. These issues are machine-specific, but it is assumed that the computations performed using QED are sufficiently well conditioned that no machine under-flow or overflow will occur in 64-bit arithmetic except for the explicit error causes noted below!) When variables are assigned a value that inherits an error, then the appropriate error flag is assigned to the variable. The except to this rule is array variables: if an error is assigned to an array variable then execution halts with an error message. Few QED programs will assign array variables outside the initialization region.

The error tag describes the nature of the first numeric error encountered in the flow of computation. The default error output for any number written by OUT or IOUT will be an asterisk followed by a number indicating the nature of the error.

ERROR NUMBER	CAUSE
1	Divide by zero
2	Logarithm of zero or negative number
3	Tangent error: Tan(x) where Cos(x) = 0
4	Input data was flagged as invalid

In addition to the "survivable errors" noted above there are a set of fatal errors that cause processing to halt with an error message:

ERROR NUMBER	CAUSE
5	Array index out-of-range
6	No data (calling program erred)
7	Attempt to assign an erring value to array variable
8	Internal Stack Overflow (QED program error)
9	Output overflow (file/memory space inadequate)

Message severity levels

QED can produce two basic classes of error messages: errors detected during parsing that indicate that your QED program is not syntactically correct; and run-time error messages that result from the fatal conditions described above. Note that QED *does not* produce an error message for survivable errors: these are simply flagged in the output data as described above.

Compile-time syntax errors

The QED parser detects a very large number of syntax errors: more than can be explicitly listed. When a syntax error is detected the output file returns an error message, the message is stored in the output file, and all further processing is halted. The error message is always of the form:

```
Syntax error = a descriptive message
      Syntax error = Bad number expression

 your line of input where the error was spotted
       example:          A := 1 + 3x2; # "3x2" is bad number
_____________________________^
                             __________^
```

The last line extends to a caret where the parser found the error. This will be at or slightly to the right of the cause of the error for most errors. However the parser does look-ahead checking for nesting errors of parentheses, brackets, index arguments for arrays, and function arguments. These errors will be detected with the error position *at the left* of the nesting region. The descriptive message will contain the word "nesting" to indicate this behavior. You can also look at the error message in the output file where the error message is copied to.

Runtime fatal errors

If a fatal run-time error is detected the output file returns *only an error message:* all output previous to the error is discarded. The error message is always of the form:

```
Fatal Run-Time Error = number, at line = number,
detected at input data row = number
```

The error number is from the table above, the "at line" references the line number in program starting from the first line after the REPEAT, and the "at input data row" indicates the row of data being processed to output when the error occurred.

Example of adding a new YESDAS sensor channel

A previous section provides detailed information on the calibration and solar information mechanisms that cover the automated processing of data from a YESDAS-2. This section shows a simple example of setting up to monitor the head temperature of an MFR-7 instrument. In an MFR-7 system, the MFR-7 Shadowband Radiometer analog instrument

cable is prewired to YESDAS-2 channels 0 through 7 via connector H15. The MFR-7 is connected as follows:

YESDAS CHANNEL	DESCRIPTION
0	MFR head temperature
1	Broadband silicon detector
2	415 nm
3	500 nm
4	615 nm
5	673 nm
6	870 nm
7	940 nm

The **.cal** and **.sol** files shipped with an MFR-7 system are configured with the MFR head temperature off. If you want to monitor the head temperature, you must perform the following tasks:

- Enable YESDAS channel 0 as either a daytime-only or all-the-time auxiliary channel. Use Initialize YESDAS to turn on this channel by creating a new profile for it. In this example, Ch. 0 will be monitored all the time.
- The **.sol** file is processed automatically by YESDAS Manager, but the rules it uses are provided below for reference. You shouldn't have to edit the **.sol** file.
- Using the QED editor you will need to modify the default **.cal** file to reflect the additional channel. A detailed example follows.

Examining the .sol file

YESDAS Manger controls the header of the Solar Information file and increases the number of data columns from 21 to 22, since the head temperature adds a data value to the output data stream. Therefore, an MFR-7 will produce three columns of output for each of seven solar channels (total, diffuse, and direct), plus one new column of output for the head temperature.

```
MULTIFILTER32 7 22  $28E6  $2A57   35502.00000
```

YESDAS Manager will add an entry for the head temperature in the LAMBDAS table, and insert new entries after the MFR head entries because the angular correction tables (at the end of the **.sol** file) reference the line numbers of the corresponding MFR channels in the LAMBDAS table. For example, the table SN1 refers to line 1, which has the Total_Si entry. In a UVMFR-7 this would be the 300 nm channel.

The name provided for each channel is later used as a label in the Solar Plots data display function. In the next three columns, the position of the data in the record is indicated, as well as the type of data in the column (either direct, diffuse or total). The MFR-7 head temperature is a total reading; no diffuse or direct readings are made, so -1 is used as a placeholder in the last two columns. YESDAS samples channels in the order of *all the time auxiliary channels*, then *shadowband diffuse channel*s, then *daytime only* (which includes the shadowband's total horizontal channels.) The data file record structure directly reflects the order in which channels are sampled by the YESDAS-2 hardware. Because channel 0 is enabled as an all-the-time channel, it appears first in the record. MFR columns are incremented by 1 since they follow this aux channel.

The last entry in the line indicates whether angular correction tables exist for the channel and whether the channel should be considered for Langley analysis. (A channel is valid for Langley analysis if it produces narrowband direct-normal solar data and is not contaminated by water vapor.) YESDAS Manager specifies NOLANG for the MFR head temperature to indicate that neither angular correction nor Langley analysis will be performed on the data for that one channel.

```
                          Total      Diffuse     Direct
LAMBDAS                     |          |          |
Total_Si                  1          8         15  TABLENL
414.5nm                   2          9         16  TABLE
499.5nm                   3         10         17  TABLE
613.5nm                   4         11         18  KEY TABLE
670.3nm                   5         12         19  TABLE
867.6nm                   6         13         20  TABLE
936.2nm                   7         14         21  TABLENL
MFR_HEAD_TEMP             0         -1         -1  NOLANG
END
```

Editing the .cal file

Open the profile and select QED Editor. If you are a new user of QED read through the file and familiarize yourself with the structure and syntax. Begin by increasing the number of data columns in the **.cal** file header by adding a new line for the label in the PRODUCES section for the MFR head temperature, wit the engineering units of `DegC`:

```
PRODUCES
MFR_Si_Total, W/(m^2)          ;
MFR_416.5nm_Total, W/(m^2)/nm     ;
MFR_501.5nm_Total, W/(m^2)/nm     ;
MFR_615.5nm_Total, W/(m^2)/nm     ;
MFR_671.1nm_Total, W/(m^2)/nm     ;
MFR_869.7nm_Total, W/(m^2)/nm     ;
MFR_938.4nm_Total, W/(m^2)/nm     ;
MFR_Si_Diffuse, W/(m^2)        ;
MFR_416.5nm_Diffuse, W/(m^2)/nm  ;
MFR_501.5nm_Diffuse, W/(m^2)/nm  ;
MFR_615.5nm_Diffuse, W/(m^2)/nm  ;
MFR_671.1nm_Diffuse, W/(m^2)/nm  ;
MFR_869.7nm_Diffuse, W/(m^2)/nm  ;
MFR_938.4nm_Diffuse, W/(m^2)/nm  ;
MFR_Si_DirNorm, W/(m^2)        ;
MFR_416.5nm_DirNorm, W/(m^2)/nm  ;
MFR_501.5nm_DirNorm, W/(m^2)/nm  ;
MFR_615.5nm_DirNorm, W/(m^2)/nm  ;
MFR_671.1nm_DirNorm, W/(m^2)/nm  ;
MFR_869.7nm_DirNorm, W/(m^2)/nm  ;
MFR_938.4nm_DirNorm, W/(m^2)/nm  ;
MFR_Head_Temp, DegC          ;
END
```

New label for head temperature

Next add a new variable to the DECLARE section to be used in calculations. In this example we use "SRT".

Finally, include a formula in the REPEAT section to convert the A/D converter mV reading into °C for each record in the data file. In most factory-supplied **.cal** files, the formual has already been included for this purpose and all you have to do is uncomment it. Use the Find button on the tool bar to locate it and remove the # symbol to uncomment the lines. Since the label for this data column appears last in the PRODUCES section, the formula (or at least the OUT statement) should appear after the MFR-7 OUT statements in the REPEAT section.

```
#MFR temp (C [+- ~1.5 deg])   ______Current data record, Data column 1
SRT := 6810 * (5000 / DATA(0,1) - 1);
SRT  := 1.030852e-3 + 2.389179e-4 * LN(SRT) + 1.574641e-07 *
LN(SRT)^3;
SRT := 1.0 / SRT - 273.12;
OUT (2,3) := SRT;
```

Notice that the number of the first data column is always 1 in the **.cal** file, but 0 in the **.sol** file. If QED produces run-time errors when processing the **.cal** file, check that the data column offset is correct.

At this point collect a data file from the YESDAS-2 you initialized (the buffer must have at least 128 bytes in it) and try to process it into calibrated data by walking through the tabs under the profile window. If successful, you should be able to view a calibrated data

plot—now check that the head temperature is plausible, somewhere between 36°C and 44°C. However, if you encounter errors carefully review your editing for syntax errors and try again