SpecWare 9
Pro and Basic Software

PRODUCT MANUAL

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1.1 Software License Agreement

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IMPORTANT: The disease and insect models used by SpecWare have been validated by state university plant pathologists for the regions of the United States in which they were developed. To determine the validity and appropriate use of a particular disease model for your specific growing region, please consult with your State Agricultural Extension Service.
1.2 Software Installation

System Requirements
SpecWare requires a 486 (or better) processor with at least 8 megabytes of RAM running Windows 95 or better. Windows 2000 or later is required for operations that require auto-scheduling (Autodownload, Frost alerts, and web publishing). You will also need a mouse and a free serial port to connect the logger to the computer. SpecWare requires a screen resolution of at least 640x480. If the screen resolution is only 640x480, then the Windows Taskbar Properties must be set to "Auto hide" so SpecWare can use the bottom 1/2" of the screen. To change the Taskbar Properties, right-mouse click on any empty area of the Taskbar (the gray bar at the bottom of the screen). Click on "Properties." Ensure that "Auto hide" has a check mark next to it. When "Auto hide" is checked, it is generally recommended that "Always on top" also be checked. Click "OK" to save any changes.

Installing SpecWare on a Hard Drive
To install SpecWare software onto your hard drive, insert the SpecWare CD into the appropriate drive of your computer and follow the on-screen instructions. If auto-start is not enabled on your computer, select Run from the Start menu and type D:\setup (Substitute the appropriate drive letter for your CD or floppy drive.) The default location for program installation is C:\Specware, but you can specify a different location if desired.

Connecting to Your IBM Compatible
The logger is connected to your computer with an interface cable. The PC-3.5 cable is designed to connect directly between the IBM compatible’s DB-9 (9-pin) serial port and the data logger. A USB-Serial adapter (available from Spectrum or at your local computer store) may be needed if your computer does not have an available DB-9 port.

Upgrading from Prior SpecWare Versions
If you have SpecWare version 6 or earlier already installed on a given computer, it is recommended that SpecWare 9 be installed in the same directory as the existing version. Multiple versions of SpecWare can co-exist without interfering with one another. Data files from earlier versions must be imported into SpecWare 9 before they can be viewed and manipulated. SpecWare cannot convert SpecWare 9 data files to a format compatible with earlier versions.
1.3 Testing the Com Port

USB-Connection

With newer personal computers, an RS-232 serial port may not be available. If you cannot es-
tablish communication with the serial port, a USB-RS232 serial port adapter (item # 3661USB) is the best option. The adapter requires a driver to be installed on your machine and will work out of a different Com Port than the RS-232 port.

Identifying the Correct Com Port

The computer Communications Port to which the PC interface cable is connected can be identified by using a paper clip. This test is performed with the cable disconnected from the logger.

1. Go to the Communications tab of the Preferences screen (see p. 8).
2. Select the com port to be tested and click on the Test Port button. If the message “Connection OK” is displayed, another device (such as a modem) is probably connected to that port. If the message “No Connection” is displayed, this port may be the one connected to your serial cable and you can proceed to the next step.

3. Place the smallest side of a standard size paperclip (about 1 3/8” long) on the end of the serial pin so that it touches BOTH the tip of the pin and the metal area between the two black rings. Again click on the Test Port button. If the message “Connection OK” now appears, this is the com port connected to your serial cable.

NOTE: The original data loggers do not short-circuit the serial pin. Therefore, when the Test Port button is clicked while the logger is connected, a “Bad Data Returned” message will be displayed.

Testing a Connection to a 1000 or 2000-Series Logger or Station

In addition to testing the PC interface cable, the connection to a 1000 or 2000-Series logger or station can easily be checked by plugging the cable into the station’s data port and hitting the 2000 button in the Preferences screen. Refer to the Communications tab of Preferences screen p. 8).
### 2.1 Preferences

Preferences must be specified when the software is first installed to allow the computer, the software and the data logger to work together harmoniously. The Preferences screen can be accessed from the File Menu option (See p. 13). The Preferences screen is divided into 5 separate tabs: General, Communications, Data Storage, Graph and Monitor. Features not available in SpecWare Basic appear grayed out.

**General**

**Units**

Allows you to choose whether data output is in English or Metric units.

**Degree Day Calculations**

The degree day calculation method specified here will be used in the reports and the insect and disease models. The Actual Degree Day Method calculates degree days using the temperatures from each logged interval. The Single Sine Method applies a smooth sine curve to estimate degree days using the daily high and low temperatures. The Growing Degree Day Method considers only the high and low temperatures for the day to compute the total number of degree days acquired (See Degree Days, p. 39).

**Location (for ET Calculation)**

The evapotranspiration algorithm incorporates specific information on weather station location. Enter latitude and altitude information in the appropriate boxes. Integer values of latitude and longitude will give sufficient accuracy.

**Growing Season Begins in Month**

SpecWare allows you to produce graphs and reports at the user-defined beginning of the growing season. To correctly compute reports for an entire growing season, it must also know whether or not the season spans 2 calendar years. This is relevant mainly for growers in the southern hemisphere. Entering the month when the growing season begins allows SpecWare to make any necessary adjustments.

**Dew Point**

Dew point will automatically be selected and its data will be saved along with the Temp and RH.

**Device Support**

All of the devices supported by SpecWare by default will be selected, unless otherwise directed by Spectrum support.
Date and Time Display
The date/time displayed on graphs can be in U.S. or international format. 24- and 12-hour clock format must be selected as well as whether the date will be shown in standard format or as a Julian Date.

Language
If the Spanish-language version has been activated, the language option to be used is selected here.

Communication

Direct Connection
Allows you to select the port that SpecWare will use to communicate with the logger. It also allows you to test the connection to a 2000-Series station. You must select the communications port connected to your serial cable (See Testing the Com Port, p. 6)

A-Series Loggers
Allows you to select the port that SpecWare will use to communicate with an A-Series logger. It does not use the standard gray PC interface cable that accompanies SpecWare Software. Instead, use the A-Series PC Connection Cable. This cable is a serial USB cable and requires that you install its USB driver prior to use.

Wireless
Allows you to select the port that SpecWare will use to communicate with a WatchDog Weather Station connected via a wireless connection. In most cases, this will be the same port that connects to the gray direct connection cable.

Modem Dial-Out
If you are connecting to the weather station via telephone, the Port field is used to select the Com Port associated with your computer's internal modem. The Modem Initialization String field is set to a common default string. Two of the more complete sites on the internet for modem information (including initialization strings) are www.modemhelp.org or www.modemhelp.net. Please reference these for other brands if the default string does not help.

Specify whether dialing is via touch-tone or pulse. Touch-tone is generally the correct option, though some phone systems use pulse dialing to minimize costs. If you hear a long series of clicks after dialing, you will need to specify “pulse” dialing.

The Wait after Connect time should generally be left as zero (the default). If the modem seems to connect, but the weather station connection fails, try setting the delay to 1 (second) to allow the modems time to finish handshaking before they are asked to transmit data.
**Advanced Features**

In general, you should not be changing any parameters on the Advanced options page.

**Direct Connect**

In the Advanced Options, Hardware Flow Control RTS should be checked, unless you are connecting to the weather station via a Short-Range Modem Pair. The Slowdown factor should be kept at 100% unless otherwise directed by Spectrum support. USB should be checked if you encounter problems with a USB-to-Serial conversion more reliable. The USB checkbox slows down communication slightly in order to make the USB to Serial conversion more reliable.

**Download Options**

Allows you to specify how the software handles the data downloaded from the WatchDog loggers or shuttle (See Downloading Original WatchDog Data Loggers, p. 22). The options are Normal, Auto Download for Shuttles only or Auto Download for all loggers. The Auto Download options retrieve the data from the loggers or shuttles and automatically save the data to the appropriate, already-created Logger Locations(s) (See pp. 27 and 29). By checking the Auto Relaunch after Auto Download box, the previously used name and recording interval are retained during the automatic launch. All Auto options proceed without user intervention.

NOTE: It's recommended that you choose Normal and confirm each step of the download, save, and relaunch process until you are familiar with how the software manages data and the data logger. *This option does not apply to 2000-series weather or mini stations.*

**Com Port Open**

The power-saving features on some PCs (especially laptop computers) will power down the serial port until it is needed. The delay in the power-up can hinder SpecWare's ability to communicate through the Com Port. The Always option tells SpecWare to open the serial port and keep it open until the software is closed. This option, however renders the Com Port unavailable for Alert and AutoDownload function until SpecWare is shut down. This situation is remedied by selecting the Fast or Pause options. For PCs that do not have energy-saving features, the Fast option tells SpecWare to immediately begin communication through the Com Port as soon as it is opened. The default option, Pause with a delay of 1 second, provides a compromise solution with minimal delay while still functioning properly on almost all PCs. The number of seconds to pause can be changed if necessary.
Data Storage

Data Folder Location
Initially displays the directory where SpecWare was installed and where Logger Location directories are being saved. The default storage location is in the SpecWare directory. This screen also allows you to specify whether or not data can be saved to diskettes (See Saving Data, p. 29).

Data File Locations
In this section, you can decide whether or not to limit the length of Logger Location names.

Palm Shuttle Hotsync File Location
When a Palm Pilot is used to download loggers in the field, SpecWare will remember the first location where Hotsync files are stored. If you want to change the Hotsync file storage location, press the Reset Location button and enter the new location in the field. Check the box if you want these files automatically deleted after they have been imported. Deletion will prevent files from being imported multiple times to SpecWare.

Graph

Initially Display
In this section, the user can select the 2 default parameters that are automatically graphed. If nothing is checked then the user must select the parameters to be graphed every time a file is opened.

Within Intervals
If the redisplay interval is longer than the measurement interval, SpecWare can display the mean value of all included data points (Display Mean) or the actual data point closest to each of the given time points (Display Closest).

Limits
For each graphed parameter, the user can specify the data range for the vertical axis. By default, the software will set the range based on the maximum and minimum values in the data set. But, for example, it may be desirable to have the horizontal axis pass through zero rather than the minimum data value. To set a maximum or minimum, select parameter of interest from the menu, enter the desired values and click the Change button.
Appearance

Show X (Vertical) grid lines
This will cause vertical lines to appear on the graph at regular intervals.

Show Y (Horizontal) grid lines
This will cause horizontal lines to appear on the graph at regular intervals.

Show Both X and Y Cursor Lines
Checking the box will add a horizontal tracker bar to the graph when it is displayed (See View, Print, and Edit Menus, p. 32).

Mark Points on Printed Graphs
If this box is checked, SpecWare will put individual data points onto the graphed line.

Data Redisplay Intervals
A Default Interval can be specified when displaying a graph from saved data files (the initial default is 60 minutes). SpecWare can graph a maximum of 8000 points, and the interval between data points depends on the time period displayed. A Minimum Interval can also be specified (the initial default is 15 minutes). This should be set to match your normal logger recording interval. Setting the Minimum Interval to the interval at which data was recorded prevents SpecWare from graphing more data points than you actually measured. This should be set to match your normal logger recording interval. For example, using data that was recorded every 30 minutes to create a graph that has a 15 minute Minimum Interval will cause SpecWare to display two points on the graph, 15 minutes apart, to represent the single recorded data point. In this case, specifying a 30 minute Minimum Interval will make the graph and text data display match your recorded data. (See View, Print, and Edit Menus, p. 32).

Monitor

This screen is used to configure your computer to automatically read and process a weather station’s current conditions. This feature uses the Windows AutoScheduler and requires Windows 2000 or greater to run.

Weather Station Real Time Monitor
Weather stations with continuous direct connections have the ability to create a separate log file using the Weather Monitor Program. This file is separate from the data recorded in the data logger. This program will only log while the Weather Monitor Program is running (See Advanced Features manual for more details).

Monitor Log and Web Output
SpecWare can regularly update the current weather conditions on a user’s web serve (See
2.2 Toolbar

After starting SpecWare, the menu bar will initially offer *File, Logger View* and *Help* menu options. The quick-buttons, from left to right, are *Exit SpecWare, Open File, Save Logger Data, WatchDog Manager, Launch/Set Properties for WatchDog 1000 or 2000, Get data from WatchDog 1000 or 2000 Series, Launch a WatchDog A-Series Logger, Get data from a WatchDog A-Series Logger, Launch Original WatchDog Logger, Get data from Original WatchDog Logger, Shuttl, (Original) Weather Station Monitor, View Logger Data as Text, Reset Zoom, Zoom Out, Change Graph Parameters* and specify *Large/Small Toolbar Buttons*.

After a file is opened or a logger is downloaded, the *Edit, Print, and Tools* menu options will appear and the *View Data as Text* and *Change Graph Parameters* quick-buttons will be activated.

Two additional quick-buttons, *Reset Zoom* and *Zoom Out*, will be activated if the graph zoom feature is used (see pp. 33-34).
2.3 File menu

Open File: Allows the user to open previously saved data files.

Save File: Allows the user to save data to a Logger Location if one is not chosen immediately after downloading a data logger.

Import Files:

- Importing PDA Shuttle File: Allows the user to import data files collected remotely by a portable, handheld computer. Contact Spectrum Technologies for information obtaining the software required for this option.

- Importing Raw Data File: Imports and interprets data files collected using SpecWare diagnostic tools.

- Convert SpecWare v 3-6: Converts data from SpecWare versions 3 through 6 to a format usable in SpecWare (See Converting Archived Data into the current SpecWare Format pg. 30).

- Import Generic Weather Data Files: This option allows you to import data files created by other weather collecting systems.

- Import WeatherLink Data Files: This option imports data collected using WeatherLink Software.

Preferences: Allows the user to select various graph, communication, data storage, and general configuration options (see Preferences p. 7)

Exit: This terminates the SpecWare session.
**3.1 WatchDog Manager**

**Introduction**

The **WatchDog Manager** screen is brought up with the quick button on the SpecWare toolbar (see **Toolbar**, p. 12) or from the **Logger** menu (p. 21). SpecWare software divides the WatchDog family of data loggers into 4 categories; 1.) 1000 or 2000-Series Logger or Stations, 2.) Original WatchDog loggers (100/200/400 series mini data loggers and 525 - 900ET weather stations), 3.) Button loggers, and 4.) A-Series Loggers (WatchDog Model A110/125/130/150 Data Logger). For the sake of brevity, in this section, the term “station” will refer to all types of WatchDog products unless a specific type of WatchDog data logger is being referred to explicitly. The **WatchDog Manager** screen can be used with all 4 types of loggers but it **must** be used for all communications with a remote weather station via a telephone modem or with multiple stations connected via a wireless multi-point setup. This screen allows you to download and relaunch a specific station as well as add and delete a station to your network.

It is possible that you will have **Logger Locations** available in SpecWare that do not appear in the **WatchDog Manager** screen. The **WatchDog Manager** screen is only used to communicate with stations. It is not used for viewing existing data files (See **Opening Files**, p. 28). Deleting a station will have no effect on data that has already been downloaded and saved from that station. Likewise, establishing a new station will not automatically create a **Logger Location**. A **Logger Location** will be created when that station is first downloaded.

**Generic Station Options**

The last 4 options in the **WatchDog Manager** screen’s list of stations are generic options. The generic options are shown in parentheses. They do not refer to a specific station but rather to
each of the 4 logger categories (1000 or 2000-Series, Original, Button and A-Series). The generic option allows you to establish contact with a station even if you don’t know its name. After selecting a generic option, you can then perform any operation available for that logger type. SpecWare is able to read the name of the station from its electronic header and carry out readout, relaunch and reconfiguration operations as if that station had been selected explicitly from the list of available stations in the WatchDog Manager screen (see Fig. 1). If you are downloading a station whose name is not on the list of stations, SpecWare will ask if you want to add that station to the list.

WatchDog Manager Toolbar Buttons

**New Station**

The **New Station** button is used to add stations to the list of available stations. After clicking this button, a blank **WatchDog Properties** screen will appear (see Properties section below for details).

**Delete Station**

This button allows you to delete an existing station from the list of available stations. Even after a station has been deleted, data downloaded from that station will be available from the SpecWare Logger Location directory.

**Autodownload Scheduler**

This button allows you to bypass the **WatchDog Properties** screen and go directly to the AutoDownload Scheduler screen (see Advanced Features manual).

**Get Current Conditions**

This option will bring up the WatchDog Real-Time monitor (see Real-Time Monitor, p. 25). This option is only available for WatchDog weather stations and 1000 or 2000-Series weather or mini stations that are in contact with the PC via a direct-connection, radio- or telephone connection. This option is grayed out for WatchDog button loggers and A-Series loggers.

**Relaunch Only**

Click this option if you want to launch a station without first downloading the data. This option may be desirable if the station is being put back into service after a period of being idle. The station will be launched with the same configuration it had the last time it read data. This option is grayed out for the 1000 or 2000-Series logger or stations because their data logging function is not interrupted by a download so the station never needs to be relaunched.

**Readout or Readout and Relaunch**

This button is used to download data from a station. For Original, Button-style and A-Series WatchDog data loggers, this option will appear as **Readout and Relaunch**. For the 1000 or 2000-Series logger or station, this option will appear as **Readout**. The data is saved to the Logger Location that matches the logger name. If this location does not exist, SpecWare will prompt you before creating it. Original, Button-style and A-Series loggers are relaunched with the same configuration they had when they were downloaded. With the **WatchDog Manager**, it is not possible, during the download process itself, to create a new location where data
should be saved. Data will always be saved to the location defined by the station name.

**Exit**

Exits the WatchDog Manager screen.

**Properties**

The **Properties** button brings up the **WatchDog Properties** screen. This screen is the gateway to all the **WatchDog Manager** configuration functions. It is used to configure a new station or to edit the configuration of an existing station. No configuration changes on this partial screen will be transferred to the station until the fully expanded **WatchDog Properties** screen (see **More** button, p. 19) has been brought up and the **OK** button has been pressed. The options for this screen are described below.

**Logger/Station Name**

Enter the name of the **Logger Location** where data will be saved. When creating a new station, this field will initially be blank. A name can only be entered for new stations. The name of an existing station cannot be changed. To change the name of an existing weather station or logger, a new station must be created with the new name. This name will then be transferred to the logger header. Caution must be exercised when changing the name of an existing station because all subsequent downloads of the station will be saved to a new **Logger Location** and it is possible all data will be erased (see **Clearing Data from a 2000-Series Station**, p. 18). The old station name will still be visible in the list of available stations. If the name change is permanent, this old station (not the **Logger Location**) can be deleted from the list of stations.

**WatchDog Type** and **Connection Type**

Select the appropriate options on this screen. For the 1000 Series, Original, Button and A-Series loggers, changes in logger configuration can only be performed with loggers that are directly connected. 2000-Series stations can be reconfigured through phone or radio connections as well. Configuration of remote stations can be most easily handled by directly connecting them to the PC and using the Generic Direct-Connect options (See **Generic Station Options**, p. 14) That way the existing connection info is not changed.
Number

If you are using a *dial-out modem*, enter the phone number in the text box. When entering a telephone number, be sure to include any additional, preceding digits required by your phone system. When using the *wireless transceivers*, enter the radio address in the **Number** text box. For 2000-Series weather or mini stations, the radio address is the same as the serial number of the station. If sending data to SpectrumWeather.com enter the 9 digit model and serial number of your station.

**AutoDownload Schedule** button

Brings up the **AutoDownload Scheduler** screen (see Advanced Features manual).

**Alert Schedule** button

Brings up the **Weather Station Alert Configuration** screen (see the Advanced Features manual).

**More** button

Clicking the **More** button causes SpecWare to initiate communication with the station. The **WatchDog Properties** screen is then expanded to display specific details about the station’s logging configuration (see Launching/Configuring Stations with the WatchDog Manager, p. 19). The expanded screen can only be brought up when a station is connected to a PC. A 1000 Series, Original, Button or A-Series logger cannot be configured or launched with a radio or telephone connection.
3.2 Clearing Data from a 2000-Series Station

Data is *not* routinely erased from the memory of a 2000-Series station. If you are moving the logger from one location to another and want to delete the station history without deleting the station, you can do so by going to **WatchDog Manager** and highlighting the appropriate station.

Click on the Advanced button, then on the Clear button. The following screen will appear:

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**Advanced Communication Functions**

The WatchDog 2000 Series logger/station retains all logged data. It does not erase its data after transmitting it to SpecWare. Instead SpecWare is responsible to ensure downloaded data is neither duplicated nor lost.

Are you sure you want to delete the log history from your WatchDog 2000 Series logger/station? If you click OK, the delete will begin immediately. Click Cancel to preserve the data on your station.

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Click the **OK** button.

SpecWare will begin erasing data. The process will take several minutes and, at this point, cannot be reversed. It is not necessary for the station to be connected to the computer once the erasure process has begun.

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**Advanced Communication Functions**

The Erase process has begun. It will take several minutes. Check the LCD screen on the station to see when it finishes.

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Click **OK**, exit out of the Advanced Communications feature by clicking on the **Exit** button. SpecWare will return to the **WatchDog Properties** screen.
3.3 Launching/Configuring Stations with the WatchDog Manager

WatchDog 1000 or 2000-Series and A-Series loggers, can be re-configured through the **WatchDog Properties** screen of the **WatchDog Manager**, or the Launch/Properties toolbar button. These stations are not launched and relaunched like the original WatchDog data loggers. Original WatchDog data loggers and weather stations can be launched through the **WatchDog Manager** as well as through the Logger menu or toolbar quick buttons (see **Launching Original WatchDog Loggers**, p. 23). The **WatchDog Manager** screen is brought up with the quick button on the SpecWare toolbar (see **Toolbar**, p. 12) or from the Logger menu (p. 21).

Note: *This screen is dynamically created and its appearance will depend on the type of logger connected.*

### Configuring/Launching a Station

The 1000-Series, Original, Button and A-Series stations can only be reconfigured when the station is connected to the PC via a direct-connect cable. The **WatchDog Manager** uses the old launch process to change the logger’s properties. 2000-Series stations can be configured with any connection type. Bring up the **WatchDog Manager** screen, select the station of interest (or the appropriate generic option), and click the **Properties** button. This will bring up the **WatchDog Properties** screen which will display the entire configuration of the station. The various fields are described on the following pages.
Data Collection Interval

The data collection interval is the amount of time that elapses between measurements.

Report (2000-Series only)

The LCD can be programmed to display additional calculated parameters by selecting that parameter from the dropdown menu of the WatchDog Properties screen. The Plant Growth report requires PAR light and air temperature sensors. The Heating Degree Day report requires an air temperature sensor or an external temperature sensor on channel D (model 2400 only). If you have purchased optional disease models for SpecWare, the dropdown menu in the Report section will show these options as well. For 1000 Series, Original and A-Series data loggers, this feature will be grayed out. The model, serial and firmware number for the logger appear to the right of the dropdown menu field.

Sensor/Units

These boxes allow you to select which parameter each external channel will measure. Click on the arrow to display the list of possible parameters. Rain gauges connected to external channels of the data loggers and 2000-Series mini stations must be assigned to Port A.

NOTE: There are several different soil moisture sensors that can be connected to WatchDog data loggers. Ensure that the appropriate type of soil moisture sensor has been selected.

Update

While connected to the computer, the Update button will instruct the logger to take a reading. It will take about 2 seconds for the reading to appear. If no sensor is connected to a particular port, “N/A” will appear for that port. With the exception of the Button and A-Series loggers, the battery status will also be displayed. The battery should be replaced when battery power drops to 25%. If a sensor type is changed for a 2000-Series station, it will be marked “Pending” and cannot be read by Update until the change is completed (by clicking “OK”).

Wrap Around

In the Wrap around when full box, you can determine how data will be handled if the logger is not downloaded before it reaches its data holding capacity. (The A-Series logger is the only one without this capability) Click in this box if you want the logger to write over the oldest data and continue reading new data. For example, if you launch for a 30 day duration, but do not recover the logger until much later, the data will reflect the most recent 30 days. If Wrap around when full is not checked, the logger will turn itself off when it is full and await recovery and readout. Wrap Around is always enabled for the 2000-Series stations and is optional for the 1000-Series loggers.

Delayed Start

This option is available for all of the data loggers. It allows the logger to begin logging at a later, pre-specified time (up to 45 days after launching your logger). Insert the date in the first box. Insert the starting time in the next box. The date/time formats should match the format selected in Preferences.

Alarm

This option is only available for Weather Stations and 2000-Series weather or mini stations. The Alarm feature works with the Alarm Output Module. Select the desired channel or parameter in the first field. A target value is entered into one or both of the other 2 fields to indicate whether an alarm is triggered if the measured value goes Above or Below the target value. Original weather stations allow only one target value. 2000-Series stations allow upper and lower alarm thresholds.
3.4 Logger Menu

WatchDog Manager
This option brings up the WatchDog Manager screen (see WatchDog Manager p. 14). This screen can be used for communicating with 1000 or 2000-Series weather or mini stations and A-Series loggers. It can also be used to readout and relaunch Original and Button loggers.

Launch/Set WatchDog 1000/2000 Properties
This establishes a connection with the 1000/2000 Series and displays the Launch Options screen. This option is equivalent to clicking on the Launch/Set WatchDog 1000/2000 Properties quick buttons.

Get WatchDog 1000/2000 Data
This established a connection with the logger and downloads data accumulated. This option is equivalent to clicking the Get WatchDog 1000/2000 Data quick button on the toolbars.

Launch WatchDog A Series
This establishes a connection with the WatchDog A-Series Data Logger and displays the Launch Options screen. This option is equivalent to clicking on the Launch WatchDog A-Series quick button on the toolbar.

Get WatchDog A-Series Data
This establishes a connection with the WatchDog A-Series logger and downloads data accumulated since the logger was launched. This option is equivalent to clicking the Get WatchDog A-Series Data quick-button on the toolbars.

Launch Original WatchDog
This establishes a connection with a WatchDog Original or Button logger and displays the Launch Options screen. This option is equivalent to clicking on the Launch WatchDog Logger quick-button on the toolbar (See Launching Original WatchDog Data Loggers, p. 23).

Get Original WatchDog Data
This establishes a connection with the logger and downloads the data accumulated since the logger was last launched. This option is equivalent to clicking the Get WatchDog Data quick-button on the toolbar (See Downloading Original WatchDog Data Loggers, p. 22).

Original Weather Station Real-Time Monitor
This launches the Weather Monitor screen (see p. 25). This is equivalent to the Original Weather Station Monitor toolbar button.
3.5 Downloading Data

WatchDog data loggers and weather stations can be downloaded with the WatchDog Manager (see p. 14) or with the Quick Button on the SpecWare toolbar (see p. 12). The Quick Button download procedure is described below.

Before downloading data, you must establish a connection between the data logger and your computer. For 1000-Series, data loggers and data shuttles, this is done with a direct connect cable. For the WatchDog button loggers, use the docking station. For weather stations, a connection can be made with the connection cable, a 75-ft direct connect cable, a short-range modem pair, a remote wireless connection or with a landline or cellular telephone connection. For the A-Series logger a connection can only be made using the WatchDog A-Series USB cable connection to PC.

Click the Get WatchDog 1000/2000, A-Series, or Original WatchDog Data quick-button or use the Logger menu to contact the WatchDog and initiate the download sequence.

As the logger is downloading, a SpecWare Progress dialog box will be visible. When the data transfer is complete, a dialog box will appear indicating that readout and translation is complete. You may then disconnect the logger from the connection cable. SpecWare will automatically prompt you to save the logger data (SeeSaving Data, p. 29). All new dataloggers require that you create a new Logger Location the first time the logger is read out. Once this Logger Location is established, subsequent logger data readouts can be appended to this Logger Location. For weather stations connected via telephone modem or a multi-point wireless system, the data will automatically be downloaded into the Logger Location with the same name entered in the ID/Location Name field of the logger header (See Launching Original WatchDog Data Loggers, p. 23) or the name given to it when it was created in the WatchDog Manager screen (see WatchDog Manager, p. 14).

After downloading WatchDog loggers, SpecWare will display a screen (see Opening Files, p. 28) that allows you to select which parameters will be graphed as well as on which vertical axis the data scale for a given parameter will be displayed. Up to 2 parameter types can be selected and all data files of that type will be displayed. The data will be displayed in a graph with the logger reading on the vertical scale and time on the horizontal scale.

IMPORTANT: Until the logger is relaunched, the data remains on the logger and can be downloaded again. Once you have retrieved data, you must relaunch the logger to continue making measurements. Clicking Start to relaunch the logger erases the previously recorded data from the logger.
3.6 Launching Original WatchDog Data Loggers

Original WatchDog Loggers can be launched with the Quick Button on the SpecWare toolbar (see p. 12). The Quick Button launch procedure is described below.

**Initiating Contact**
With the logger connected to the interface cable, initiate the launch process by using the Logger menu or by selecting the appropriate logger type and clicking the Launch Original WatchDog quick-button (See p. 12). The Launch Options screen will appear. Initially, the screen will display the current launch configuration. Any of the launch configuration parameters can be changed except whether the data is output in English or metric units (See Preferences, p. 7).

To launch the logger, click on the **Start** button. When the logger is actively reading, the LCD will indicate the logger status. On loggers lacking an LCD, a red LED will flash. (It will flash only dimly every four seconds during the delay period of a delayed launch.) Click the **Cancel** button to exit the Launch Options screen without launching the logger.

**CAUTION:** Clicking the **Start** button erases previously recorded data from the logger. Until **Start** is clicked, that data is available for download.

**NOTE:** Do not unplug the logger from the interface cable until SpecWare has indicated that the launch has been completed.

**Launch Options Screen**

**Header**
The top field of the dialog box gives a description of the logger and its serial number. Neither the description nor the serial number can be changed. The header will also show the current date and time on your computer. This information will be transferred to the logger when it is launched.

**ID/Location Name**
The text in this box can be used to identify the **Logger Location**. Up to 40 characters can be written in this area. The logger location entered will become the default location for saving the data.

**Measurement Interval and Maximum Duration**
The interval is the amount of time that elapses between measurements. After selecting the interval, the maximum duration (time it will take to completely fill the logger) is calculated and displayed by SpecWare, this feature is only available on the Original Data Loggers.
Port Enabled
On the WatchDog data loggers you can enable or disable the ports by checking or unchecking the appropriate boxes of their external ports. The sensors that come standard (including the solar radiation sensor on the 900ET station) are always enabled.

Sensor/Units
These boxes allow you to select which parameter each logger channel will measure. Click on the arrow to display the list of possible parameters. Rain gauges connected to external channels of the 1000/2000 Series or mini data loggers must be assigned to Port A.

NOTE: There are four different soil moisture sensors that can be connected to WatchDog data loggers. Ensure that the appropriate type of soil moisture sensor has been selected.

Update
While connected to the computer, the Update button will cause the logger to take a reading. It will take about 2 seconds for the reading to appear. If no sensor is connected to a particular port, “N/A” will appear for that port. For the WatchDog (except model 100), the battery status will also be displayed. The battery should be replaced when battery power drops to 25%.

Alarm
The Alarm feature is only active with Weather Stations connected to an Alarm Output Module. Select the desired channel or parameter in the first field. Indicate in the second field whether the alarm module is triggered when the measured parameter Goes Above or Goes Below the target value entered in field 3. See the Alarm Output Module User’s Guide for more details.

Wrap Around
In the Wrap around when full box, you can determine how data will be handled if the logger is not downloaded before it reaches it’s dataholding capacity. Click in this box if you want the logger to write over the oldest data and continue reading new data. For example, if you launch for a 30 day duration, but do not recover the logger until much later, the data will reflect the most recent 30 days. If Wrap around when full is not checked, the logger will turn itself off when it is full and await recovery and readout.

Delayed Start
The Delayed Start box will appear for those loggers that are capable of using this option. It allows the logger to begin logging at a later, pre-specified time (up to 45 days after launching your logger). Insert the date in the first 3 boxes in the format mm/dd/yyyy. Insert the starting time in the next 3 boxes. The time uses a 12-hour format; you must enter “am” or “pm”.

3.7 Real-Time WeatherMonitor

WatchDog Original Weather Stations

The first launch of a station will enable the Original Weather Station Real-Time Monitor option in the Logger menu and the Original Weather Station Monitor quick-button on the SpecWare Toolbar screen (see p. 12). Clicking either the menu option or the quick-button will display one of the first two monitor screens shown on p. 26. (Note: once the Original Weather Station Real-Time Monitor is initialized, SpecWare does not have to remain open to display the monitor screen.) The monitor screen displays the current weather conditions including readings from the sensors that are plugged into the external ports of the weather station.

IMPORTANT: For the Real-Time Weather Station Monitor to work correctly, the weather station must be connected to the computer using the optional hardwire or remote PC connections.

The data on the monitor screen is updated by clicking on the Refresh button on the lower left part of the screen. Clicking the Repeat Refresh button will cause the monitor screen to update every five minutes.

The amount of Rain since the last download/launch and current Rain amount since the last Reset are displayed on the lower right corner of the monitor screen. There may be several rainfall events between the times that data is downloaded to the computer (see Downloading Original WatchDog Data Loggers, p. 22). Click the Reset Rain button to zero the currently accumulated Rain amount.

The bar graph is composed of Air temperature, Dew point and wind Chill. The green and blue horizontal lines on the bar graph are the daily high and low temperatures.

NOTE: If SpecWare cannot make a connection when trying to bring up the Real Time Monitor, the user may need to end the task (SpecWSM8) in the Task Manager. You can bring up the Task Manager by simultaneously clicking the Cntrl-Alt-Delete buttons on the keyboard.

1000 or 2000-Series Data Stations

The monitor screen for the 1000 or 2000-Series stations can only be activated by clicking the Get Current Conditions option in the WatchDog Manager. A sample screen is shown on p. 26.
Monitor screen generated by toolbar quick-button for all Original stations (except the model 800).

Monitor screen generated by toolbar quick-button for a Model 800 station.

Monitor Screen generated by WatchDog Manager screen. Note: This is the only option available for the 1000 or 2000-series mini– and the weather station.
4.1 Data Management

SpecWare offers significant advantages in data information management and decision-making tools. SpecWare simplifies your database with Logger Location directories. This permits easier analysis of trends and historical data.

The database is the permanent record of data stored on your hard drive. When you download the logger, SpecWare transfers all information in the logger memory to the computer and you have the option of saving to an existing Logger Location. For Original WatchDog data loggers and weather stations, it is also possible to create a new location to save the logger data. Suggestion: Use the “ID/Location Name” box that appears in the logger “Launch Options” screen as your Logger Location (e.g. North Orchard). Each Logger Location in SpecWare is a subdirectory in C:\Specware. If you choose to save your downloaded logger data to a floppy diskette, it is important to use a separate floppy diskette for each location because of the way data files are built by SpecWare.

The software stores data to disk in monthly files. All parameters are recorded in the same file in a subdirectory named for the Logger Location. As new data is downloaded from the logger, it is appended to the appropriate month for the location you have specified. The name of the data file indicates the year and the month of the data. For example, SD201002.swd is the data for February 2010. Each Logger Location directory must contain an index file (index.swd). This index file is used by SpecWare to identify which parameter is associated with each column in the data files. For this reason, care must be exercised when transferring or copying data files from one Logger Location to another.

CAUTION: The files in each Logger Location are given the same names as those in other Logger Locations. Therefore, it is important to carefully choose the Logger Location when adding new data to existing locations or to floppy diskette to avoid mixing the data from separate locations.
4.2 Opening Files

Open File
Click the Open Logger File(s) toolbar button or the Open File option from the File menu to bring up the Open Logger Files screen. From the upper box, select the Logger Location where the file is located. Data files saved on a floppy disk can also be retrieved (A: drive).

Data Redisplay Options
SpecWare offers 3 data redisplay options. These options are shown in the Select Time Period to Display field in the lower right corner of the Open Logger Files screen.

The first option allows you to view only the most recent data in the selected Logger Location. Enter the time interval of interest in the two text fields. The dropdown menu allows for time increments of days, weeks, or months. It is possible to exclude the current week or month of data. This may be desirable if the data has just been downloaded or if you want to look at data from the last complete time interval.

The second option instructs SpecWare to display all data from the beginning of the growing season defined in the General tab of the Preferences screen (see p. 7).

The third option allows you to select a specific range of months. The months are selected from the list in the lower left corner of the Open Logger Files screen. Multiple months can be selected by holding down the left mouse button and dragging the cursor or by selecting the first month and, while holding the shift key, selecting the other months with the arrow keys.
The third option is SpecWare's default mode. One of the other options can be set as the default by clicking the box at the bottom of the screen. The newly selected default setting will not be universal but will only apply to the specific **Logger Location** for which it has been selected.

After selecting the Logger Location and data redisplay interval options, clicking the **Open** button will bring up the **Change Graph Parameters** screen (shown to the right). This screen allows you to select which parameters will be graphed as well as the vertical axis that will be used. Only 1 parameter can be plotted on the Y1 axis, but multiple parameters can be plotted on the Y2 axis. The data on the graph will also be visible under the horizontal axis. This is especially useful when multiple parameters are plotted on the Y2 axis (See **View, Print and Edit Menus**, p. 32).

### 4.3 Saving Data

Data downloaded from 1000 or 2000-Series weather or mini station is automatically saved to a **Logger Location** with the same name as the **Logger/Station Name** assigned in the **Properties** screen (see **WatchDog Manager**, p. 14).

#### Saving Files Downloaded from Original WatchDog Stations

When you download the data from an original logger, the **Save Logger Data** box will appear. Choose the directory where you want to save the file. You may append the data files into an existing **Logger Location**, save them to a newly created **Logger Location**, or save to a floppy disk. If you decide to create a new location, you will be prompted to name this location. Generally, the data will be saved to a logger location in the SpecWare directory on the drive where the software was installed. Files can also be saved to the floppy disk drive (A: or B: drive) if this option is selected in the **Data Storage** tab of the **Preferences** screen (see pg. 9). If you choose to not save your data at this time, click on the **Cancel** button to go directly to the graph screen. You can save the data later by selecting the **Save File** option from the **File** menu. Otherwise, you will be reminded to save the file if you attempt to open another file or exit from the program.

#### Using Your Data in Other Applications

SpecWare creates an ASCII file for use in other applications as soon as a downloaded file is saved. The file is tab-delimited for use in spreadsheets, word processors and other applications. These raw data files are located in the SpecWare directory in a folder named for the **Logger Location**.
NOTE: If a data file is changed by a different application (i.e. Excel), do not save to this application with the original file name. By default, the format will be changed and SpecWare will be unable to read the modified file.

IMPORTANT: All new data loggers require that you create a new Logger Location. Once this Logger Location is established, subsequent logger data readouts can be appended to this Logger Location.

4.4 Converting Archived Data into the Current SpecWare Format

The data file format for SpecWare versions 6 and earlier is different than the current format. Instead of having a unique monthly data file for each parameter, all data collected in a given month is included in one master data file. This file has a .swd extension associated with it. An index.swd file is also included in the Logger Location folder to allow SpecWare to process these data files into reports and graphs.

Data files created in earlier versions of SpecWare can be converted into the current file format used by SpecWare. Select Convert SpecWare v3-6 Files from the Import Files menu within the conversion screen (Fig. 6). All Logger Locations Select the location that contains the data you wish will be converted. If you wish to only convert cer-

![Figure 5](image)

![Figure 6](image)
4.5 Importing Data

There are several instances when it may be necessary to import data files into SpecWare. All import functions are accessed from the Import Files option in the File menu (see p. 13). After the files to be imported have been selected, the Save Logger Data box will appear. If more than one file has been selected, each file will be imported in succession. You may append the data files into an existing Logger Location, save them to a newly created Logger Location or onto a floppy disk (see Saving Data p. 29). The various input options are listed below.

Importing .wdr Files

Palm/PDA Files
Files that have been transferred to a PC from a Palm Pilot or other PDA device must be imported into SpecWare. Select Import PDA Shuttle File from the Import Files dropdown menu. This will bring up a screen that allows you to browse to the location of the saved data files.

Raw Data Files
Some files that have been created by using WDTest to extract raw data from a data logger or weather station may be imported directly into SpecWare. This will not be possible if the files need to be repaired by Spectrum Technologies before they can be imported. Select Import Raw Data File from the Import Files dropdown menu. This will bring up a screen that allows you to browse to the location of the saved data files.

Importing Weather Data Files

WeatherLink Data Files
SpecWare is able to import and process files that were initially downloaded with WeatherLink software. These files will have a suffix of .wlk. Select Import WeatherLink Data Files from the Import Files dropdown menu. This will bring up a screen that allows you to browse to the location of the saved WeatherLink data files.

Note: WeatherLink considers midnight to be the last data point of the day. SpecWare considers midnight to be the first data point of the day. Therefore, if a WeatherLink file has a data point for midnight, SpecWare will create a SpecWare file for the same month, plus a file for the following month containing only the last midnight record.
Generic Weather Data Files
SpecWare is able to import and process weather data files that were initially created with other data logging software. The data must be text files in tab-delimited format. One line in the file must contain SpecWare-specific keywords that identify which weather parameter is contained in each column of data. The date and time information must be in the first one or two columns. Select the Import Generic Weather Data Files option from the Import Files dropdown menu. This will bring up a screen that allows you to browse to the location of the saved weather data files. Select one or more files and click Open. In the SpecWare File Import Options screen, specify how the data file is configured. This configuration can be stored as the default by clicking the Save as Default button. Otherwise, click the OK button and proceed with saving the data in SpecWare. Refer to Appendix 1, (p. 50) for details on creating generic data files.

4.6 View, Print, and Edit Menus

Viewing Your Data as a Graph
Upon downloading data or opening an existing file, you must select the parameters to view. SpecWare will display the Change Graph Parameters screen (see p. 34). This screen will also appear when opening new files (see Opening Files, p. 28). Select which parameters will be graphed and on which vertical axis (Y1 or Y2) the data scale for a given parameter will be displayed. The data will be displayed in a graph with the logger reading on a vertical scale, time on the horizontal scale and the legend shown underneath the graph. As the cursor is moved across the graph, the time and data values are displayed at the bottom of the screen.

Only 1 parameter can be plotted on the Y1 axis. The data scale on the Y1 axis will be in the units of the parameter being displayed. The Y2 axis, however, can be used to plot multiple parameters. If only one parameter is being plotted using the Y2 axis, the data scale will be in the units of that parameter. However, if the Y2 axis is being used to plot more than 1 parameter, the data scale will range from 0 to 100. All data plotted with Y2 as its vertical
reference axis will, therefore, be normalized to a scale of 0 to 100. Each parameter has a
default range that is used to do the normalization. The default ranges encompass most data
values that will be seen in the field. This range can be modified in the Graph tab of the
Preferences screen (p. 10). When more than 1 parameter is plotted on the Y2 axis, the actual
numerical values of each plotted point can be still be seen beneath the graph. The following
example is given for illustration:

Example: The default range for solar radiation is 0 to 1,250 W/m². Assume, during a given
month, the peak solar radiation was 550 W/m². If solar radiation is plotted on the Y2 axis along
with one or more other variables, its maximum normalized value will be 44 [because 100 x
(550/1250) = 44]. However, if in the Preferences screen, the default range is changed to 0 to
600 W/m², the normalized graph of solar radiation will then have a peak of 92 [because 100 x
(550/600) = 92]. In both cases, “550 W/m² will be displayed as the value beneath the graph.

Viewing Your Data as Text
Click on the View Data as Text quick-button or on the View Data as Text command in the View menu. A
WordPad or Notepad window (depending on what is available on your computer) will overlay the graph and
display the numerical data for that graph.

Printing Your Graph
Click on the Print Graph command under the Print menu to print the graph displayed on the screen.

Printing Your Data as Text
Click on the Print Text File command under the Print menu on the Graph/Data Screen to print
the numerical data for the graph displayed on the screen.

NOTE: The data displayed using the View Data as Text or Print Text File commands may not always be the raw data as recorded
by the data logger. The data displayed has been adjusted to fit
uniform time periods for the purpose of graphing (See Data
Redisplay Intervals, p. 10 and Using Your Data in Other
Applications, p. 29).

Zooming in on any Plot Selection
You can zoom in on any section of the plot. This function is particularly useful when the plot
encompasses a large data set. Note that when the cursor is within the graph box, a Tracker
Bar appears. A vertical Tracker Bar is always present. It is also possible to display a
horizontal Tracker Bar by setting this option in the Graph tab in the Preferences screen (see
Graph p. 10). As the Tracker Bar is repositioned on the graph, the corresponding date, time,
and associated data values appear in the status bar below the graph. To zoom in on a
particular section of a graph, position the cursor at one end of the time interval of interest.
While holding down the left mouse button, drag the Tracker Bar to the other end of the time
interval. After releasing the mouse button, the software will display a graph of the chosen
region.
Zooming Out One Level
To return to a previous graph after zooming in on your graph, click on the **Zoom Out** quick-button (magnifying glass without the red circle) or the **Zoom Out One Level** command in the **View** menu. Each time this button is clicked, the screen will return to the previous screen developed during the zooming-in process.

Returning to the Original Plot View
After zooming in on the data displayed in the graph screen, click on the **Reset Zoom** quick-button (magnifying glass with red circle) or the **Reset Zoom** command in the **View** menu to return to the original graph.

Copying Graph
To copy the graph as a bitmap for use in other applications, select **Copy Graph** from the **Edit** menu.

Change Graph
Selecting this option from the **Edit** menu will bring up the **Change Graph Parameters** screen. This screen can also be accessed from the **Change Graph Parameters** quick-button on the SpecWare toolbar. When this option is selected, the **Change Graph Parameters** screen will appear. Select the parameter(s) of interest and click the **Redraw** button to produce the new chart.

![Change Graph Parameters quick-button](image)

![Change Graph Parameters screen](image)
### 5.1 Tools Menu

The **Reports** screen is available in the **Tools** menu on the SpecWare toolbar (see Toolbar, p 12). The **Reports** screen has 5 tabs: **Select Report, Where and When, Options, Forecast, and View Report.**

![SpecWare 9 Pro - SpecDemo](image)

### 5.2 Reports

#### 5.2.1 Select Report

This screen allows the user to select the report of interest. There are two Report Categories: Standard Reports (pp. 39-43), and Custom Reports (p. 44). The Standard Reports are predefined reports for each of the sensor types. Custom Reports allow you to create your own report in which you choose which parameters are displayed. SpecWare Basic cannot create Custom Reports.
5.2.2 Where and When

This screen allows you to produce reports for Logger Locations other than the one currently open. Initially, the default values for the location and process dates are from the file that is currently open. To generate a report for another location or date, select a new Logger Location and enter the desired time period in the Process Dates boxes. The calculations can begin and end on any date within a single year. SpecWare will not use data outside the chosen time period. To generate a report that begins in one year and ends in the next (e.g. Chill Hours) you must calculate each year separately and manually sum the results.

IMPORTANT: For your chosen Location, make sure the Process Dates are included in the Available Months and that the Available Data include the appropriate parameters needed for the chosen Report or that are needed to drive the chosen disease or insect model.

![SpecWare Reports - Degree Days](image)

5.2.3 Options

This screen allows modification of parameter ranges and boundary conditions specific to the Report, Disease, or Insect Model of interest. Environmental inputs may include temperature, humidity, and leaf wetness limits. It may also be necessary to enter relevant biofix dates to indicate some visible stage of plant, disease, or insect development. A spray date may be required to update infection potential calculations from that point on. If a generally accepted value for a parameter exists, it is shown as the default. Consult your State Agricultural Extension Service for assistance in determining the appropriate values for your area. Once an appropriate value for each
of the parameters is determined, click on **Save Parameters** to avoid having to re-enter the values the next time the model is used.

Forecast data can be entered for some disease and insect models. It is possible to include forecast data for some other reports and predict environmental conditions up to one week in the future. It is also possible to enter forecast data for the present date if data for the entire day was not logged. Check the **Forecast Today** box and enter the expected values for today’s **Low** and **High** temperature, **Hours above 90% RH**, **Rainfall** amount and **Wet Leaf Hours**. Likewise, enter a forecast for the next seven full days by entering values for these parameters on the line next to the appropriate
date. When the report is viewed, an asterisk (*) will appear next to the forecasted
dates to distinguish predictions based on forecasts from those based on actual
measured data.

5.2.5 View Report

On this screen, Report parameters or the results from disease or insect models are
displayed. If several different university models exist for a disease, they are shown in
separate columns on the same report.

You can save the current report by clicking the Write Text File button. In the Save As
screen, type a filename and select the directory where it will be saved.

Clicking Print will cause the report to be sent directly to the printer.

The Copy to Clipboard button allows the report to be copied and pasted into another
document that has, for example, been created in a word processing or spreadsheet
program.

NOTE: If the report is saved directly to a spreadsheet with Copy to Clipboard, it will
not be separated into separate columns. To parse the information into separate
columns, use Write Text File to create a separate file. Then open that text file in
spreadsheet software (such as MicroSoft® Excel) as a space-delimited file.
Alternately, with Excel, if the text file is copied directly into the spreadsheet, the “Text
to Columns” option from Excel’s Data menu will also bring up the Text Import Wizard.

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5.3 Standard Reports

5.3.1 Degree Days

Degree Days are computed for the Standard Degree Day Report (see figure below), Custom Reports, and for the Insect Models. SpecWare calculates the total degree days accumulated and requires temperature data measured by the thermistor inside the WatchDog. External temperature sensors cannot be used to generate these reports. (See Soil Temperature Hours, p. 42). Three methods are used to calculate degree days; Growing Degree Day, Single Sine, and Actual Degree Day.

The Growing Degree Day Method (GDD) considers only the high and low temperatures ($T_{\text{high}}$ and $T_{\text{low}}$) for the day along with user-selected values for the base and upper limit temperatures to compute the total number of degree days acquired. The formula is:

$$\frac{1}{2}(T_{\text{high}} + T_{\text{low}}) - \text{Base}$$

If $T_{\text{high}}$ is above the upper limit, the upper limit is used for $T_{\text{high}}$. If $T_{\text{low}}$ is below the base temperature, the base temperature is used for $T_{\text{low}}$. In addition to the GDD, both the Single Sine and Actual (Integral) Degree Days are also displayed in the GDD report. The Single Sine method uses the day's maximum and minimum temperatures to generate a sine curve. The area between this curve and the lower threshold temperature is the GDD. The Actual Degree Days (ADD) method employs a calculation similar to the GDD but is done at each measurement interval rather than on daily values. The ADD method is the most accurate.
5.3.2 Chill Hours

SpecWare calculates the total chill hours. Chill hours are calculated as the amount of time spent below a base temperature and above the lower limit.

![Chill Hours Report]

5.3.3 Leaf Wetness Hours

Leaf Wetness Hours

SpecWare calculates the total leaf wetness hours accumulated between an upper and lower temperature limit. This report requires leaf wetness and temperature data.

![Leaf Wetness Hours Report]
5.3.4 PAR Light, DIF/DLI

SpecWare calculates photosynthetically active radiation (PAR) received. The PAR Light report shows total hours of accumulated PAR above a user-determined minimum light intensity and total moles meter\(^{-2}\) day\(^{-1}\) of photons. The PAR sensor may be plugged into any port on the WatchDog. If multiple PAR sensors are connected to the same WatchDog, a separate column is established for each PAR sensor. SpecWare also calculates DIF and Daily Light Integral (DLI). DIF is the average day temperature minus the average night temperature. This value is used to determine stem elongation. When day temperature is warmer than night temperature (positive DIF value) plants will become taller. When day temperature is cooler than night temperature (negative DIF value) less stem elongation will occur. DLI is the sum of all recorded PAR light throughout an entire day. DLI influences root and shoot growth as well as flowering.

5.3.5 Temperature/RH Hours

SpecWare calculates the hours of relative humidity that occur above an optional minimum percent RH and between a user-specified base and upper temperature limit. The report shows the sum of hours in which both the temperature and relative humidity conditions were satisfied.
5.3.6 Soil Temperature Hours

SpecWare reports the high, low, and mean soil temperature for each day. Integrated hourly degree days are calculated for each day using the user-specified lower and upper temperature limits.

5.3.7 Day, Month, or Year Summary

Day, Month, or Year Summary
SpecWare summarizes the available data by hour for any single day, by day for any single month, or by month for any single year selected in the Where and When screen. For each summary, the temperature limits for calculating degree days and chill hours can be specified in the Options screen. The lower leaf wetness threshold and temperature range for calculating the hours of leaf wetness can also be specified.

Day Summary (by Hour) reports mean hourly values of temperature, relative humidity and PAR light, hourly accumulation of degree days, chill hours, rainfall and the length of time the leaves were wet during the hour. High and low temperatures for the time period of interest, as well as the time they occurred, are given at the bottom of the report. Only one day’s data can be displayed.

Month Summary (by Day) reports the daily mean temperature, high and low RH, high and low temperatures and the time they occurred, daily accumulation of degree days, chill hours, rainfall and the length of time the leaves were wet during the day. Only one month’s data can be displayed.
Year Summary (by Month) reports the monthly mean temperature, high and low temperatures and the day they occurred, monthly accumulation of degree days, chill hours, leaf wetness hours, rainfall, the length of time the leaves were wet during the month and the number of days that rain fell during the month. High and low temperatures for the year and the day they occurred are given at the bottom of the report.

5.3.8 NOAA/Irrigation Report

NOAA Report
SpecWare summarizes weather station data in a format approved by the National Oceanic and Atmospheric Association. The NOAA report includes the daily mean temperature, high and low temperatures and the time they occurred, daily accumulation of integrated-hourly degree days, daily solar radiation in average watts meter$^2$ day$^{-1}$, daily mean RH, daily rainfall, and the daily mean wind speed and maximum wind gust. The Options screen is used to specify the temperature limits for calculating degree days. Only one month’s data can be displayed.

Irrigation Report
A summary of the daily mean soil moisture readings as well as the amount of time the soil moisture tension was above or below the user-specified soil moisture range. If data from a state sensor (item# 6451) is available, the last 2 columns will report the length of time the irrigation system was pressurized and how many gallons of water were applied to the field. The soil moisture range and irrigation flow rate are set in the Options tab (see Options p. 43).
5.4 Custom Reports

SpecWare Pro gives users the ability to create customized, daily summary reports. Any parameter measured by the WatchDog data logger or weather station can be included in these reports. After entering the Custom Reports module (see Fig. 7) in the SpecWare Reports screen (see Select Report, pg. 35), you have the option of adding a new report or modifying or deleting an existing report. To delete a report, highlight the name and click the Delete Custom Report button in the lower left corner. To add a report, click the Add New Custom Report button and give a name for the new report in the Create New Custom Report Screen (see Fig. 8).

To modify an existing report, simply highlight that report. The details about this report will then appear in the Report Columns field on the right-hand side of the screen. Columns in a report are added, modified and deleted with the appropriate button in the lower right-hand side of the Custom Reports module.

Adding/Modifying a Custom Report Column

To modify an existing column, highlight that column from the Report Columns field. This will bring up the Report Columns Options screen (Fig. 9). This same screen will also appear if a new column is being added. From this screen, there are four options that must be selected. They are as follows:
Sensor Type

The sensor type selected in the first field will determine what options are available in the other three fields. If the Same option is selected, the sensor used in the previous column will also be used in the column being added. The column headings for each report column appear in the Report Headers field above the Report Columns field.

Port

After a sensor type has been selected, this option identifies the channel to which the sensor of interest is connected. The default option for this category is Primary. If Primary is selected, SpecWare will initially look for an internal sensor of that sensor type. If none is found, it will look for the data file of the first external sensor (in alphabetical order) of that sensor type. This option should be selected if there are no duplicate sensors connected to the WatchDog. If more than one of the same sensor type is connected to the data logger, select the location of the specific sensor that should be used in the report.

If a letter (A - H) is selected, data from the sensor connected to this port will be used in the report. The External option is similar to Primary except SpecWare will only look for external sensors (currently, the only sensor type that can be either an internal or external sensor is temperature). The Any option is used for reports that contain data from several sensors of the same sensor type but, for which, the port the sensors are connected to may change or vary from logger to logger. When Any is selected, SpecWare will look for the first data file of that sensor type that has not already been used in the report.

Note: If a sensor type/location combination does not exist (for example, the Custom Report requires a solar radiation on channel B but no such data file exists because a temperature sensor is actually connected to that port), that report column will be blank when the report is displayed or printed out.

Display

The Custom Reports module presents information gleaned from an entire day of data. The option selected here determines what information for the chosen sensor will be displayed. The options are summarized on the following pages:

Mean, High, and Low—SpecWare will display the mean, high or low value measured by the selected sensor.
**Hrs**—SpecWare will display the amount of time that the selected sensor was measuring values above a user-selected threshold value. The field for entering this information will be in the same part of the screen where base temperature and upper limit are entered for degree day reports (see fig. 10).

**DD, ADD, GDD and DDSine**—This option is only available for temperature data. SpecWare will display the number of degree days accumulated for the day based on a user-defined base temperature and upper limit (see fig. 10). The definitions of the different degree day options are:

- DD: Degree Days
- ADD: Actual Degree Days
- GDD: Growing Degree Days

See [Degree Days](p. 39) for more details on degree day computation.

**Flow**—This option is only available for data from the Irrigation On/Off sensor. Based on a user entered irrigation system flow-rate, SpecWare will display the total amount of irrigation water that was applied during the day.

**HiHrs and LoHrs**—This option is only available for soil moisture data. SpecWare will display the amount of time the selected soil moisture sensor was above (HiHrs) or below (LoHrs) a user-defined threshold value.

**And Also**

With some options, the Custom Reports module gives the user the option of adding additional information that supplements the Display column. This can be in the form of an additional column or an additional line of information at the end of the report. The options are summarized below:

**None**—This is the default option. If it is selected, no supplementary information will appear in the report.

**Time**—This option is available with the High and Low Display options. It creates an additional column that indicates when the respective high or low value occurred.

**Cumulative**—This option is available with the Sum, Flow, Hrs, HiHrs, LoHrs and Degree Day display options. It creates an additional column that shows a running total of the accumulation of the desired parameter up to, and including, the day for which it is displayed.

**Total**—This option is available with the Sum, Flow, Hrs, HiHrs, LoHrs and Degree Day display options. It creates an additional line at the end of the report that shows the sum of the desired parameter over the entire time range under consideration.
Optional Disease and Insect Models

SpecWare software includes models to predict infection events for the following diseases and for insects. These models are provided FREE for a 30 day evaluation. If the user desires continued use of any of the disease or insect models after the evaluation period, or if any model was purchased initially with SpecWare, the user must contact Spectrum Technologies, Inc. for a registration number.

Before calling Spectrum, click on the Help button on the main toolbar. Then click on “About SpecWare” A dialog box will appear with both the Serial Number and Registration Number. Call, fax, or e-mail Spectrum with this information. Currently, the optional disease and insect models are as follows:

<table>
<thead>
<tr>
<th>Catalog #</th>
<th>Disease/Insect Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>3656GA</td>
<td>Grape Alert</td>
</tr>
<tr>
<td>3656 BR</td>
<td>Black Rot (Guignardia bidwellii)</td>
</tr>
<tr>
<td>3656 BT</td>
<td>Botrytis (Botrytis cinerea)</td>
</tr>
<tr>
<td>3656 DM</td>
<td>Downey Mildew (Plasmopara viticola)</td>
</tr>
<tr>
<td>3656 PC</td>
<td>Phomopsis Cane Leaf Spot (Phomopsis viticola)</td>
</tr>
<tr>
<td>3656 PD</td>
<td>Powdery Mildew (Uncinula necator)</td>
</tr>
<tr>
<td>3656AP</td>
<td>Apple/Pear Alert</td>
</tr>
<tr>
<td>3656 AS</td>
<td>Apple Scab (Venturia inaequalis)</td>
</tr>
<tr>
<td>3656 FB</td>
<td>Fire Blight (Erwinia amylovora)</td>
</tr>
<tr>
<td>3656 SB</td>
<td>Sooty Blotch/ Flyspeck (Peltaster fruticola and Leptodotium elatius Zygiophiala jamiaacacenis)</td>
</tr>
<tr>
<td>3656TU</td>
<td>Turf Alert</td>
</tr>
<tr>
<td>3656 BP</td>
<td>Brown Patch (Rhizoctonia solani)</td>
</tr>
<tr>
<td>3656 DS</td>
<td>Dollar Spot (Sclerotinia homoeocarpa)</td>
</tr>
<tr>
<td>3656 PT</td>
<td>Pythium Blight (Pythium aphanidermatum and P. graminicola)</td>
</tr>
<tr>
<td>3656PO</td>
<td>Potato Alert</td>
</tr>
<tr>
<td>3656 EB</td>
<td>Early Blight (Alternaria solani)</td>
</tr>
<tr>
<td>3656 LB</td>
<td>Late Blight (Phytophthora infestans)</td>
</tr>
<tr>
<td>3656TO</td>
<td>Tomato Alert</td>
</tr>
<tr>
<td>3656 TC</td>
<td>Tom-Cast (Alternaria solani, Spetoria Lycopersici)</td>
</tr>
<tr>
<td>3656CH</td>
<td>Cherry Alert</td>
</tr>
<tr>
<td>3656 LS</td>
<td>Cherry Leaf Spot (Blumeriella jaapii)</td>
</tr>
<tr>
<td>3656 IN</td>
<td>Insects</td>
</tr>
</tbody>
</table>

For detailed descriptions of each model, refer to the SpecWare Disease and Insect Guide.
The first launch of a 900ET Weather Station will enable the Evapotranspiration (ET) report option in the Tools menu on the SpecWare Toolbar.

**Note:** The station **Latitude** and **Altitude** must be set in the Preferences screen (see p. 7).

### Where and When
This screen allows you to produce reports for **Logger Locations** other than the one currently open (see p. 36).

### Crops
The evapotranspiration (ET) value computed by SpecWare is the potential ET of a grass crop. Actual ET for a specific crop at a specific growth stage can be computed with a crop coefficient (k). The default k-value is 1.0. Crop coefficients are generally available from local extension services. This screen allows you to build reports for multiple crops. To see what crops are already entered, click the arrow to expand the **Crops** field. After choosing a crop, the data that has been entered for that crop can be seen in the **Begin Dates - K Factors** field. To add a crop, left-click the **Add** button under the **Crops** field, enter the crop name, and click **OK**. Enter the k factor and first date that factor is to be used by clicking the **Add** button under the **Begin Dates - K Factors** field. Multiple k factors and begin dates can be entered for each crop, allowing the user to track crop water status as plant water requirements change. The ET report can display the results of applied irrigation for each crop. Click the **Add** button under the **Irrigation Dates and Amounts** field and enter the irrigation date and amount of water applied. To change or delete data entered for any crop, highlight the data to be changed and click **Delete**. Re-enter new or updated data as needed by using the **Add** button.
The **Report** screen lists the daily values for the parameters used to calculate ET. Daily Reference ET is displayed and the Crop ET is calculated using the $k$ values entered on the **Crops** screen. Irrigation events are displayed as entered on the **Crops** screen and from the values for Irrigation. Crop ET, Rainfall, the daily Net Water increase or decrease, and the Cumulative Net water increase or decrease are also displayed.

**Graph**
The **Graph** screen is a pictorial display of pertinent information using the values from the **Report** screen.
There are some conventions that must be followed when creating a generic weather data file to be imported into SpecWare. There must be one row that has keywords that identify the type of data in each field of the subsequent rows of data. The list of SpecWare 3-letter keywords, along with the units for each parameter, are shown in table 1. Note that some parameters can be in English or metric units. It is important that the unit system selected in the Preferences screen (see p. 7) correspond to the units in the generic data file. The RAW option can be used for any sensor that does not correspond to any of the default categories recognized by SpecWare. For any parameter that is present multiple times in the data file (because multiple sensors of the same type were deployed), an additional letter (A - P) should be added to the end of the 3-letter keyword to distinguish one field from another. The date and time must occupy the first field or the first two fields. The keyword(s) associated with date/time fields are not critical, but SpecWare assumes the date precedes the time. Again, the date and time should follow the format selected in Preferences. The rows of data must also be tab-delimited and in the same sequence as the keywords. It is not necessary that the row of keywords be the first row in the text file. A sample data file is shown in Figure A1.

Note: Growing Degree Days will only be computed with temperature data in the column with keyword TMP.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>TMP</th>
<th>TMPA</th>
<th>HMD</th>
<th>SMSA</th>
<th>SMSB</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/1/2006</td>
<td>13:42</td>
<td>78</td>
<td>93</td>
<td>45</td>
<td>30</td>
<td>63</td>
</tr>
<tr>
<td>5/1/2006</td>
<td>13:57</td>
<td>77</td>
<td>91</td>
<td>46</td>
<td>30</td>
<td>63</td>
</tr>
<tr>
<td>5/1/2006</td>
<td>14:12</td>
<td>77</td>
<td>91</td>
<td>46</td>
<td>30</td>
<td>63</td>
</tr>
<tr>
<td>5/1/2006</td>
<td>14:27</td>
<td>79</td>
<td>89</td>
<td>44</td>
<td>30</td>
<td>64</td>
</tr>
<tr>
<td>5/1/2006</td>
<td>14:42</td>
<td>80</td>
<td>90</td>
<td>44</td>
<td>31</td>
<td>64</td>
</tr>
</tbody>
</table>

Figure A1. Example of a generic data file that can be imported into SpecWare.
<table>
<thead>
<tr>
<th>Spectrum key word</th>
<th>Parameter</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAR</td>
<td>Barometric Pressure</td>
<td>In-Hg or mm-Hg</td>
</tr>
<tr>
<td>CO2</td>
<td>Concentration of CO₂</td>
<td>ppm</td>
</tr>
<tr>
<td>HMD</td>
<td>Relative Humidity</td>
<td>%</td>
</tr>
<tr>
<td>MAM</td>
<td>Amperage</td>
<td>mA</td>
</tr>
<tr>
<td>PAR</td>
<td>PAR Light</td>
<td>μMole/m²s</td>
</tr>
<tr>
<td>RAW</td>
<td>Raw Sensor</td>
<td>none</td>
</tr>
<tr>
<td>RNF</td>
<td>Rainfall</td>
<td>Inches or mm</td>
</tr>
<tr>
<td>SMS</td>
<td>Soil Moisture Tension</td>
<td>kPa</td>
</tr>
<tr>
<td>SRD</td>
<td>Solar Radiation</td>
<td>wat/m²</td>
</tr>
<tr>
<td>STA</td>
<td>State Sensor</td>
<td>On/Off (1 or 0)</td>
</tr>
<tr>
<td>TMP</td>
<td>Temperature</td>
<td>°F or °C</td>
</tr>
<tr>
<td>VLT</td>
<td>Voltage</td>
<td>V</td>
</tr>
<tr>
<td>VWC</td>
<td>Volumetric Water Content</td>
<td>%VWC</td>
</tr>
<tr>
<td>WET</td>
<td>Leaf Wetness</td>
<td>LW</td>
</tr>
<tr>
<td>WND</td>
<td>Wind Direction</td>
<td>Degrees</td>
</tr>
<tr>
<td>WNG</td>
<td>Wind Gust</td>
<td>mph or km/h</td>
</tr>
<tr>
<td>WNS</td>
<td>Wind Speed</td>
<td>mph or km/h</td>
</tr>
</tbody>
</table>

Table A1. SpecWare keywords for use with generic data files
Commonly Asked Question

Q. When selecting Launch or Readout, the software gives the message “Can’t connect to data logger” or “WatchDog Logger Timeout”. What’s wrong?

A. Try changing the battery. Otherwise, this is probably a serial port problem:
   1. Make sure that the interface cable is pressed all the way into the jack on the logger.

   2. The interface cable must be connected to a working serial port. If the serial port was recently used for a network mouse, the port may still be configured as such. When removing a mouse, reboot your system.

   3. If the logger still fails to connect, the battery could be low. Replace the battery and try to connect again.

   4. Set and/or test the communications port settings through the Preferences screen in the File Menu.

   5. Check if software for any external devices (such as a palm pilot) has been installed on your hard drive.

Help is available under Help Topics or the Knowledge Base at www.specmeters.com