WatchDog®

WeatherTracker 305
Greenhouse Growth Tracker

PRODUCT MANUAL

Item # 3501PAR

Spectrum®
Technologies, Inc.

CONTENTS

This manual will familiarize you with the features and operation of your new WeatherTracker. Please read this manual thoroughly before using your instrument. For customer support, or to place an order, call Spectrum Technologies, Inc.
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FAX at (815)436-4460
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Spectrum Technologies, Inc
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General Overview

Thank you for purchasing a WeatherTracker. This model allows you to conveniently monitor air temperature as well as quantum light. Current conditions and historical data are easily viewed on the station's LCD screen.

The internal electronics calculate Growing Degree Days (GDD) for up to three degree day counters. For example, one counter can be activated at planting while another can track the development of insects. The station also calculates Chill Hours, which is the total amount of hours during which temperatures have been below a specified low temperature. The arrow keys allow you to scroll through the sensor readings, Degree Day/Chill Hour calculations as well as set your temperature ranges. Using a quantum sensor the WeatherTracker monitors the PAR light available and records it as mol/day.

Sensors	**Measurement Range**	**Accuracy**
Quantum Light Sensor	0-2500 $\mu mol \cdot m^{-2}s^{-1}$	±5%
Temperature Sensor	-4° to 158°F (-20° to 70°C)	±1°F (±0.7°C)

Station Installation

The WeatherTracker has the versatility to be located in any micro-climate for recording weather data. Hardware is included for attaching it to a 1" to 1¼" outside diameter mast (pipe). The Weather-Tracker should not be mounted on a supporting post of the greenhouse. It should be set up in the middle of a bench, free from the canopy. The radiation shield protects the temperature sensor from solar radiation and other sources of reflected heat.

Figure 1: WeatherTracker mounted on 1" conduit

Archives

The WeatherTracker features two archives that allow you to look at historical data for that location. The archives are regularly updated whenever the WeatherTracker is actively collecting data. The archives are accessed by pressing the **Current/Archive** key (see pg. 8).

Daily Archive
The Daily Archive retains the last 30 days of data. If the battery power runs low, the WeatherTracker will stop measuring and archiving data until the battery is replaced. See **Keypad Operation** (p. 7) for information on accessing the archive information.

After using the arrow key to select a certain day from the Daily Archive, the WeatherTracker will then cycle through all the information stored for that day. This will include a screen with the high and low temperatures for that day, any active degree day counters and the average readings for any sensors connected to the device. If a currently active Degree Day Counter was not active on that day, the screen will say "No Data".

Monthly Archive
The Monthly Archive retains 12 months of data. When a month is selected, the WeatherTracker will then cycle through all the information stored for that month. This will include a screen with high and low temperatures for the month, degree day data and the cumulative rainfall (if applicable) for that month. If a currently active Degree Day Counter was not active at the end of a month, the screen will say "No Data" for that month.

Note: If an active Degree Day counter is disabled or reset, the entire archive for that counter will be erased (see Parameter Update Screens, p. 9).

Meter Operation

The WeatherTracker does not have a button or switch for powering up and down. Instead, the device is operational whenever the battery is installed. The battery connection can be accessed by removing the face plate (fig. 2). Exercise care when replacing the plate to ensure the buttons aren't damaged. When replacing or reinstalling the battery, the time and date must be reprogrammed (see Parameter Update Screens, p. 11). The Current Conditions screen (see p. 9) is updated every 20 seconds.

Note: If an active Degree Day counter is disabled or reset, the entire archive for that counter will be erased (see Parameter Update Screens, p. 9).

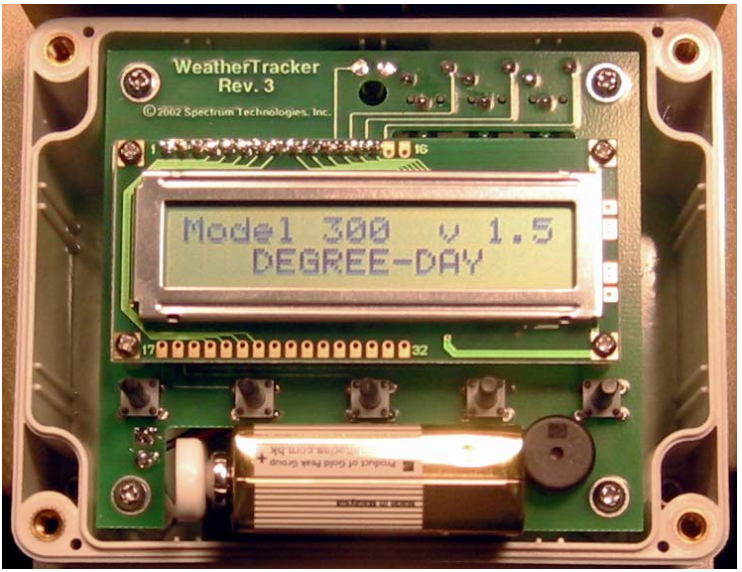


Figure 2: WeatherTracker Battery Compartment

Keypad Operation

Display

Pressing the **Display** key once brings the LCD display to life. The screen will initially display descriptive information about the station. The screen then displays current conditions. Pressing the **Display** key a second time will deactivate the display. The station continues to record conditions when the display is not active. To conserve battery power, the display goes off after 2 minutes of inactivity.

Press the **Arrow** key to scroll through the different screens. Initially, the screen will display the latest Weather Tracker information. The **Current Conditions** screen displays the current values being read by the sensors.

Model 305 v 1.6 DD Quantum	*-Initial information screen*
TEMP 74°F PAR: 0049µM 00.9M/Day	*-Current Conditions*
HI 74°F 12:00 AM LO 66°F 01:58 PM	*-Daily High and Low Values*
DD #1 50-86° 16 Since 07/03 2125	*-First Degree Day Value*
DD #2 50-86° 16 Since 0/8/06 1145	*-Second Degree Day Value*
DD #3 52-78° 11 Since 09/12 925	*-Third Degree Day Value*
09-08-02 07:09PM BATTERY AT 90%	*-Time, Date* *-Battery Level*

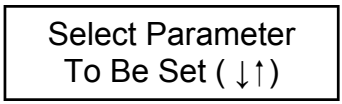
Keypad Operation (Cont.)

Current Archive

After the display is activated, pressing the **Current/Archive** key once will put the LCD into the "Daily Archive" mode. Press the **arrow-down** key to select the day for which you wish to view archival data. Press the **Current/Archive** key again to enter "Monthly Archive" mode. Press the **arrow-down** key to select the month for which you wish to view archival data. The arrow buttons are then used to review the last 30 days of daily history or the last 12 months of monthly history. Pressing the **Current/ Archive** key again will allow you to see the Current Val-

Set

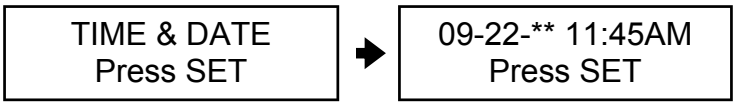
Pressing the **Set** key will bring up the **Parameter Option Screen** which will allow you to scroll through all parameter options and change any of the station's settings. These include time/date, display units and degree day and chill hour temperature ranges. Use the arrow keys to scroll to the parameter of interest and press the **Set** key again to enter a parameter update screen. Once in a parameter update screen, pressing the **Set** key will allow you to scroll through the different components of that parameter. The component that is modifiable will display *****'s. At this point, use the arrow keys to adjust that component. After the last component has been set, the LCD screen will return to the Current Conditions screen. Press the **Set** key again to modify more parameters.



-Parameter option screen.

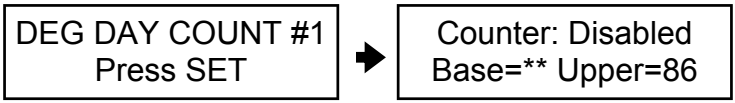
Keypad Operation (Cont.)

Parameter Update Screens:



Successively pressing the **Set** key will allow you to set the month, day, year, hour, and minute.

Allows you to select whether temperature is displayed in ^{o}F or ^{o}C. If ^{o}C is selected, rainfall will be displayed in mm.



Allows you to select the base and upper temperatures used in the Degree Day calculations as well as configure a Degree Day counter. A Degree Day counter will display one of two modes; Enabled or Disabled. When a Degree Day counter is enabled, it is actively computing and summing degree days and adding to the Daily and Monthly archives. If the **Set** key is pressed to make this parameter modifiable (see description of **Set** key on p. 8), the user has two options; Disabled or StartNow. The Disabled option will turn off the counter and remove it from the archive and list of display screens (see p. 7). The StartNow option erases all the data from the archives and resets and restarts that counter from zero.

Caution: Be careful when entering a parameter update screen for a Degree Day counter when that counter is enabled. If the **Set** key is pressed, the counter status will become modifiable and the archives WILL BE ERASED. If this is not desirable, press one of the arrow keys instead of the **Set** key to exit the screen.

Light

The quantum sensor approximates PAR light, the radiation between 400 and 700 nanometers, that are the most influential wavelengths for optimum plant growth. Position the sensor in an appropriate area to monitor plant conditions. Make sure the quantum sensor is not being shadowed or blocked. Contact your cooperative extension agricultural agent for further suggestions on field placement and inspect the sensors frequently to make certain the sensors are clear of obstructions. Use the bubble level to ensure that the sensor is horizontal.

PAR light is needed for the plant to function properly. Light requirements differ between crops, but the rule of thumb is to allow the maximum amount of light possible. Growers commonly apply shade to decrease temperature and improve foliage. In some crops such as tomatoes, the yield was directly proportional to the amount of light. Limiting light may cause the stomates to close preventing the leaves from cooling off. The WeatherTracker monitors the light available and records it as moles/day (Peet, 2002).

Moles/day is the unit for the Daily Light Integral (DLI) the amount of light present during a day. The DLI varies with the seasons, increasing in the spring and decreasing in the fall. The greenhouse film and structure allows 35-70% of the light to reach the plants. Environmental factors like dust and dew can also block light. Light transfer is hard to asses using the human eye since it adjusts immediately to the current light level. The only way to verify light quantity is to use a light meter (Faust, 2002).

Plant-Specific Light Requirements

Light quantity is measured in a daily light interval (DLI) which refers to the total amount of light a plant receives in one day. A plant requires a minimum DLI like it requires a certain amount of rainfall. The following values were obtained from a set of experiments performed at Clemson University.

SPRING EXPERIMENT

The spring experiment measured plant development at 0% shade (18 mol/day), 25% shade (12 mol/day), 50% shade (6 mol/day), and 75% shade (3 mol/day).

Plant	Commercially Acceptable Quality	Highest Quality
Begonia	6 mol/day	12 to 18 mol/ day
Pansy	N/A	18 mol/day
Marigold	6 mol/day	N/A
Angelonia	12 mol/day	18 mol/day
Petunia	N/A	N/A
Impatiens	3 mol/day	6 to 12 mol/day

Plant-Specific Light Requirements

SUMMER EXPERIMENT

The summer experiment measured outdoor plant development at 0% shade (38 mol/day), 50% shade (15 mol/day), 70% shade (6 mol/day), and 90% shade (3 mol/day).

Plant	Commercially Acceptable Quality	Highest Quality
Agertum	15 mol/day	> 15 mol/day
Vincia	7 mol/day	N/A
Zinnia	N/A	38 mol/day

FALL EXPERIMENT

The fall experiment measured outdoor plant development at 0% shade (30 mol/day), 50% shade (13 mol/day), 70% shade (8 mol/day), and 90% shade (3 mol/day).

Plant	Commercially Acceptable Quality	Highest Quality
Geranium	13 mol/day	30 mol/day
Melampodium	8 mol/day	30 mol/day

General Light Requirements

Light Quantity (Daily Light Integral-DLI)	**Results**
< 5 mol/day	Produces poor quality plants
5-10 mol/day	Produces commercially acceptable plants Produces high quality plants for shade-adapted species
10-20 mol/day	Produces high quality plants

Growing Degree Days

Temperature is a key factor contributing to the development of plants, insects and plant diseases. Degree Days are a way to quantify the amount of heat that is available, which is a function of the time the temperature is within a given temperature range. For example, if the base temperature is determined to be 40 degrees and the actual temperature is 41 degrees for 24 consecutive hours, one Degree Day is said to have accumulated (41 – 40 = 1 degree for 24 hours or 1 day). Degree Days indicate the developmental stage of a pest generation. This allows for more precise pesticide recommendations.

The WeatherTracker calculates Degree Days using the integral method. Degree Day values are calculated at 15 minute intervals to produce Degree Quarter-Hours (DQH), which are then summed over a full day. DQH are calculated as follows:

$DQH = T_{avg} - T_{base}$

Where T_{avg} is the average temperature over the 15-minute interval and T_{base} is the base temperature. If the average temperature is greater than the upper limit of the temperature range, the upper temperature limit is used instead of the average temperature when calculating DQH. If the average temperature is less than the base temperature, DQH is set equal to zero for that interval.

References

Faust, James E. "Light Management in Greenhouses" 2002. http://www.firstinfloriculture.org/pdf/2002-5_LightManagement_pt_1.pdf (2002-Nov-26)

Holcombe, Veronda B., Kelly Lewis, and James E. Faust. "How Much Light Do Bedding Plants Really Need?" *Greenhouse Product News* July 2001:26-30.

Peet, Mary M, "Greenhouse Vegetable Production" 2002. http://www.ces.ncsu.edu/depts/hort/greenhouse_veg/more_info_/stress3.html (2002-Nov-26).

Warranty

This product is warranted to be free from defects in material or workmanship for one year from the date of purchase. During the warranty period Spectrum will, at its option, either repair or replace products that prove to be defective. This warranty does not cover damage due to improper installation or use, lightning, negligence, accident, or unauthorized modifications, or to incidental or consequential damages beyond the Spectrum product. Before returning a failed unit, you must obtain a Returned Materials Authorization (RMA) from Spectrum. Spectrum is not responsible for any package that is returned without a valid RMA number or for the loss of the package by any shipping company.

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