# Surna Reflector Controller

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## Overview

The Surna Reflector Controller will be capable of providing central control of up to 256 Surna reflectors via up to 32 Reflector Interface boards, each of these supporting up to 8 individual reflectors. The Controller will regulate temperature in up to 8 zones in grow using the Surna Enviro Monitor as a source of temperature, humidity and CO2 measurement. Each Zone can contain between 8 and 256 reflectors, in increments of 8. Zone temperature is controlled by varying the speed of fans fitted in each reflector as a group. By default outputs on each Enviro Monitor to be used to control humidity, CO2 and supplemental heating and cooling. The controller is a Modbus RTU host to the Reflector Interfaces and Enviro Monitors that are under its control. It features a Modbus RTU slave port for connection to a Surna Master Controller to provide overall facility control by passing on environmental and other data.

Each EnviroMonitor has 4 outputs capable of controlling relays. Each output defaults to a function, as detailed below:

Output 1 activates each time the system calls for more cooling than the reflectors alone can supply. This occurs if the average temperature exceeds two degrees higher than the current set point. The output remains on until the average temperature falls to the current set point. This output can be used to activate supplemental cooling.

Output 2 activates each time the measured humidity is above the humidity set point. This output remains active until the humidity falls to 3% below the humidity set point. This output can be used to activate dehumidifiers.

Output 3 activates each time the average temperature falls two degrees below the current set point. The output remains on until the average temperature reaches the set point. This output can be used to activate supplemental heating.

Output 4 activates each time the CO2 concentration falls below the lower set point and turns off when the CO2 concentration rises above the upper set point. This output is interlocked with the day mode detection so CO2 will not be delivered during darkness.

## Hardware

The Surna Reflector Controller is based on a common hardware platform to the Surna Chiller Staging Controller termed an “SCS”. This hardware is also used for other devices. It features a backlit two line LCD display and simple three button UI for user input. The device is housed in a NEMA 4 enclosure suitable for mounting either inside or outside a grow room. Typically it would be mounted in a corridor outside the rooms it is controlling. Wiring to the Reflector Interfaces and Enviro Monitors is via a 5-6 core screen cable in a daisy chain configuration. Power is supplied to the unit through the Interfaces and / or from the System Controllers Modbus RTU Bus.

## Firmware

Firmware is resident in the unit to provide all control functions either stand alone or in conjunction with a system controller. Without the system controller the device will be limited to controlling grow room temperature and simply reporting the other measured parameters. The next level is via a Surna Smart Node that forwards this information to a simple web page and can accept user input. Using the Node as a host the reflector system may be monitored and controlled from a local device that can interact with a web page, such as a smart phone, tablet or computer.

The system will also provide detection and annunciation of communication failures, reflector over temperature, fan failure and other errors with a latched output for connecting an external annunciator.

## System Control

The system will control temperature and humidity by reading the current ambient in each zone and averaging It over a period, coming out with a difference between the current and desired values. This difference will be scaled over a plus and minus scale and using this scale, converted to a fan percentage speed of either 0 or somewhere between 30 and 100%. The resulting fan speed is then passed to all the reflector interfaces assigned to that zone. The control algorithm is designed to simulate the lag between changing air flow and a resulting temperature change so the result is a gradient rather than an abrupt change. When the result is outside the range, outputs are provided to add optional supplemental heating, cooling and de-humifaction.

## Parameter Control

The Modbus interface allows setting and reading of controller parameters. These are split up into 4 groups, Zone, Interface and Reflector. The reflector values are actually read back from each reflector and are not writable.

Zone Oriented Registers – Showing one of eight identical sets.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Holding register | Function | Length | Values and Range | Default |
| 40001 (0) | Zone 1 Day Temperature Set Point | One word | 65.0 to 90.0 degF | 77.0 degF |
| 40002 (1) | Zone 1 Night Temperature Set Point | One word | 65.0 to 90.0 degF | 75.0 degF |
| 40003 (2) | Zone 1 Current Temperature -  Read Only | One word | 0.0 to 125.0 degF | 0.0 degF |
| 40004 (3) | Zone 1 Relative Humidity - Read Only | One Word | 0.0% to 100.0% RH | 0.0 % |
| 40005 (4) | Zone 1 Air Pressure – Read only | One Word | 0 to 1500mbar | 0 |
| 40006 (5) | Zone 1 CO2 - Read only | One Word | 0.0 to 4000.0 ppm | 0.0 |
| 40007 (6) | Zone 1 Day / Night -  Read only | One word | 0 = Night, 1 = Day | 0 |
| 40008 (7) | Zone 1 Active | One word | 0 or 1 | 1 |
| 40009 (8) | Zone 1 PWM -  Read only | One word | 0 – 100% | 0 |
| 40010 (9) | Zone 1 Temperature Trim | One word | -2.0 to +2.0 | 0.0 |
| 40011 (10) | Zone 1 Average Temperature - Read only | One word | 0.0 to 125.0 degF | 0.0 |
| 40012 (11) | Zone 1 Temperature Offset - Read only | One word | -2.0 to +4.0 | 0.0 |
| 40013 (12) | Zone 1 Status | One Word | TBD | 0 |
| 40014 (13) | Zone 1 Good Packet Count | One Word | 0-9999 | 0 |
| 40015 (14) | Zone 1 Error Packet Count | One Word | 0-9999 | 0 |
| 40016 (15) | Zone 1 Altitude | One Word | 0 to 20000ft in 100ft increments | 0 |
| 40017 (16) | Zone 1 Day High Humidity Set Point | One Word | 55% to 70% | 65% |
| 40018 (17) | Zone 1 Night High Humidity Set Point | One Word | 55% to 70% | 65% |
| 40029 (18) | Zone 1 Low Humidity Limit | One Word | 35% to 50% | 40% |
| 40020 (19) | Zone 1 temperature differential | One Word | 2degF to 5degF in 1 degF | 3 degF |
| 40021 (20) | Zone 1 CO2 low set point. Setting off disables the CO2 dosing output | One Word | Off or 800ppm to 1000ppm | Off |
| 40022 (21) | Zone 1 CO2 high set point. Setting off disables the CO2 dosing output | One Word | Off or 1200ppm to 1600ppm | Off |
| 40023 (22) | Light On Set point  This is the light on time in 15 minute increments. | One Word | A day-minute value of 0 to 1440 in 15 minute increments | 0 |
| 40024 (23) | Light Off Set point  This is the light off time in 15 minute increments | One Word | A day-minute value of 0 to 1440 in 15 minute increments | 0 |
| 40025 (24) | Zone output 4 options | One Word | 0 : No output 4  1 : CO2 on output 4  2 : Lights on output 4 | 0 |
| 40026 (25) to 40030 (29) | Unused | 5 Words | Read -1 | -1 |
| 40031 (30) to 40060 (59) | Zone 2 data | 30 words |  |  |
| 40061 (60) to 40090 (99) | Zone 3 data | 30 words |  |  |
| 40091 (90) to 40120 (119) | Zone 4 data | 30 words |  |  |
| 40121 (120) to 40150  (149) | Zone 5 data | 30 words |  |  |
| 40151 (150) to 40180  (179) | Zone 6 data | 30 words |  |  |
| 40181 (180) to 40210  (209) | Zone 7 data | 30 words |  |  |
| 40211 (210) to 40240  (239) | Zone 8 data | 30 words |  |  |
|  |  |  |  |  |
| 40241 (240) | Interface 1 Zone | One word | 1 - 8 | 1 |
| 40242 (241) | Interface 1 Channels – One bit set to enable each channel | One word | Bit 0 = Channel 1  Bit 1 = Channel 2  Bit 2 = Channel 3  Bit 3 = Channel 4  Bit 4 = Channel 5  Bit 5 = Channel 6  Bit 6 = Channel 7  Bit 7 = Channel 8 | 0 |
| 40243 (242) | Interface 1 Status | One word |  | 0 |
| 40244 (243) | Interface 1 good packet count | One word | 0-9999 | 0 |
| 40245 (244) | Interface 1 error packet count | One word | 0-9999 | 0 |
| 40246 (245) | Interface 1 Temperature Limit | One word | 90.0 to 120.0 degF | 0.0 |
| 40247-255 246-254) | Unused | 9 words | Read -1 | -1 |
| 40256 (255) to 40270 (269) | Interface 2 data | 15 words |  |  |
| 40271 (189) to 40820 (819) | Interface 3-32 data | 450 words |  |  |
|  |  |  |  |  |
| 40821 (820) | Options | 1 Word |  |  |
|  |  |  |  |  |
| 40822-999 (821-998) | Unused | 178 Words | Read -1 | -1 |
| 41000 (999) to 43999 (3998) | System parameters | 3000 Words | See standard system parameters |  |
|  |  |  |  |  |
| 44001 (4000) | Reflector 1 PWM | One word | 0-100% | 0 |
| 44002 (4001) | Reflector 1 Internal Temperature | One word | 0.0 to 256.0 degF | 0.0 |
| 44003 (4002) | Status | One word | Bit mapped | 0 |
| 44004-010 (4003-4009) | Unused | Seven Words | Read -1 | -1 |
| 44011 (4010) to 44020 (4019) | Reflector 2 data | 10 words |  |  |
| 44021 (4020) to 46600 (6599) | Reflector 3 to 256 data  Read Only | 2540 words |  |  |