

INSTALLATION, OPERATION & SERVICE MANUAL

INTELLUS ULTRA CONTROLLER MANUAL

DESTINATION: India
MODEL: I30VL
SO#: 035909
S/N: 35909.01.25

The manual provided is designed to cover the standard configurations for the chamber you ordered. Any special features or optional items ordered are presented below.

Your chamber is equipped with the following:

- IntellusUltra Connect controller
- IncuWhite® linear LEDs *
- Open loop dimmable lighting
- Phenolic coated cooling coil *
- Door lock *
- 12 shelf clips (SCL-005)
- No shelves, time delay or voltage monitoring relays or drain tubing

* - Please refer to the section titled Associated Diagrams, Schematics and Miscellaneous Information for special installation and/or operation instructions.

Note: All supplemental information supersedes any similar information provided in the standard manual.



I30 Series Chamber

Operator's Manual

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Introduction

To help customers *create better science*, Percival Scientific continuously studies and refines the design of its products to provide the best possible solutions and equipment in the industry. As such, changes in the design and/or operation of equipment may occur without publication. Please feel free to contact Percival Scientific directly for product updates.



**Please read this manual
carefully before proceeding
with operation**

Revision Log

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Rev A	10/4/2024	Initial Release

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Warranty Information

Equipment Limited Warranty

Thank you for purchasing equipment from Percival Scientific, Inc. Our goal is to provide every customer with an exceptional ownership experience. We are committed to providing products and services of the highest quality, and your satisfaction is our top priority. In support of this objective, we present the following warranty.

Warranty Terms

Percival Scientific, Inc. (hereinafter referred to as Percival) warrants that equipment manufactured by Percival shall be free from defect in material or workmanship, when installed, operated and maintained in accordance with instructions provided by Percival.

Warranty Coverage

- Coverage period shall be twenty-four (24) months from the date of delivery
- Percival's obligation under this warranty is limited to the repair or replacement of defect at no charge for parts, shipping and labor
- Percival reserves the right to inspect the equipment after a warranty claim is made to determine the proper course of corrective action

Exclusions

- Parts or elements damaged from improper installation, including mechanical, electrical and plumbing services, IT infrastructure, inadequate room ventilation, improper water quality, and ambient conditions that are out of specification
- Parts or elements damaged from improper operation
- Parts or elements damaged from improper maintenance
- Parts or elements considered to be consumable, that outlive their normal expected terms of usefulness, such as: light bulbs, filters, desiccant material and CO₂ scrubbing media)
- Damage resulting from shipment to or relocation within the customer's facility after equipment has been signed for and ownership is transferred to the customer
- Modification to equipment by the customer without Percival's consent may void this warranty
- Repair work undertaken without prior consent of Percival may void this warranty
- Damage caused by accident, fire, Force Majeure or Acts of God

Additional Terms

- This warranty is in lieu of any other warranties, expressed or implied, including merchantability or fitness for a particular purpose
- Warranty terms described herein cannot be changed without the expressed, written consent from Percival
- The owner agrees that Percival's sole liability with respect to defective parts or materials shall be set forth in this warranty, and any claims for incidental or consequential damages are expressly excluded
- This warranty is non-transferable and applies only to the original purchaser
- Repaired or replaced parts shall be warranted only for the unexpired portion of the original warranty, unless otherwise defined
- Parts replaced under warranty shall become the property of Percival

To Make a Warranty Claim

1. Document the issue with detailed notes and photographs along with the equipment's serial number
2. Contact Percival's customer support team at customerservice@percival-scientific.com, parts@percival-scientific.com or 1-800-695-2743
3. Once your claim is received, our customer support team will review it and contact you with further instructions

Definitions

‘Controlled environment chamber’, ‘Incubator’, ‘Chamber’ and ‘Unit’ are all used interchangeably in this manual to describe the complete controlled environment chamber system manufactured by Percival Scientific, Inc.

General

This manual is intended to provide instructions on the installation, operation, maintenance and troubleshooting of Percival Scientific’s I30 Series biological incubator product line.

Biological incubators play a crucial role in various scientific and medical fields, serving as controlled environments for the growth and maintenance of biological samples. These versatile devices find extensive applications in microbiology, cell culture, and molecular biology research. In microbiology, incubators are used to cultivate and study microorganisms under optimal temperature, humidity, and atmospheric conditions. This is essential for identifying pathogens, testing antimicrobial agents, and developing new vaccines. In cell culture laboratories, incubators provide the ideal conditions for growing and maintaining cell lines, tissues, and organoids, supporting research in areas such as cancer biology, stem cell research, and drug discovery.

Beyond research applications, biological incubators are indispensable in clinical settings, biotechnology industries, and entomological studies. In hospitals and diagnostic laboratories, they are used for culturing patient samples to diagnose infections and determine antibiotic susceptibility. The pharmaceutical industry relies on incubators for drug development and quality control processes, including stability testing of new medications. In entomology, incubators are crucial for studying insect development, behavior, and physiology. They allow researchers to control environmental factors such as temperature, humidity, and light cycles, which are essential for rearing insects, investigating their life cycles, and conducting experiments on pest control methods. Entomologists use incubators to study insect responses to various stimuli, assess the effects of pesticides, and even explore the potential of insects in sustainable food production. Additionally, biological incubators find applications in food science for studying food safety and quality, as well as in environmental research investigating the impact of various conditions on microbial ecosystems. The versatility and precision of modern biological incubators continue to advance scientific discovery and progress across numerous disciplines, including the field of entomology.

Equipment Overview



Product Specifications

Model			I-30NL	I-30L
Temperature Range	Lights Off	Low	2.0°C	
		High	44.0°C	
		Range	±0.5°C	
	Lights On	Low	N/A	5.0°C
		High	44.0°C	
		Range	±0.5°C	
Exterior Dimensions		Width	31.0 in (78.7 cm)	
		Depth	23.8 in (60.5 cm)	
		Height	46.2 in (117.4 cm)	
Interior Volume		ft ³	9.6	
		m ³	0.3	
		L	272.1	
Number of Tiers			3	
Shelves per Tier			1	
Shelf Dimensions		Width	26.5 in (67.3 cm)	
		Depth	16.5 in (41.9 cm)	
Total Shelf Area		ft ² (m ²)	9.1 (0.85)	
Growing Height per Tier		in (cm)	9.0 (22.9)	8.7 (22.1)
Door Opening		Width	26.8 in (68.1 cm)	
		Height	29.8 in (75.7 cm)	
Light Intensity @ 6" (μmol/m ² /s)			N/A	125
Electrical		VAC	120V	
		Phase	1	
		Frequency	60Hz	
		Cords (NEMA)	1 (5-15P)	
		RLA	7.7A	7.9A
		MCA	9.6A	9.9A
Heat Rejection to Ambient		Btu/h (W)	1221 (358)	1338 (392)
Shipping Weight		lb (kg)	230 (104)	250 (113)

Installation

To achieve and maintain optimum performance from the unit throughout its designed operating range(s), it is important to install the chamber according to the following guidelines. Failure to follow the installation guidelines in this section may cause loss of environmental control, malfunction, premature system failure and may also void the manufacturer's warranty.

Site Preparation

The following considerations should be made when preparing a facility for installation of Percival controlled environments:

Location

Locate the chamber in a clean area with a level surface and adequate space for door swings, ventilation, access of facility services and the unit's service connections and access panels.

Prior to the unit's delivery date, ensure there is a clear path from the delivery dock to final chamber location, taking doorways, elevators, corridor widths and turns into account.



Warning! The I30 Series chamber is heavy. Please use caution when removing the unit from its shipping container and while moving it into position. These tasks should be undertaken with care by more than one person.

Spatial requirements vary by chamber model and optional equipment. Please refer to all supplementary installation instructions as optional equipment can change the space required for a chamber's proper operation.

Space required for installation of the standard I30 Series controlled environment chamber is shown below:

Ambient Conditions

Published chamber performance specifications are based on the following ambient environmental conditions. To ensure best performance of the I30 Series controlled environment chamber, locate the unit in an environment where the following conditions can be maintained:

Temperature = 75 °F (23.8 °C)

Relative Humidity = 55 %RH

Chamber Heat Rejection to Ambient

To achieve and maintain specified conditions within a controlled environment chamber, the unit's cooling system must remove excess heat from within the chamber. This excess heat is rejected from the system and must be accounted for when planning for a chamber's installation.

The base I30 Series chamber models' estimated maximum heat rejection to ambient can be found in the Product Specifications section of this manual.

It is necessary to ensure the HVAC system where the chamber is installed has sufficient capacity to remove heat rejected by all chambers within the space. Insufficient heat removal capacity will result in elevated ambient temperatures and possible degradation in chamber performance.

Electrical Services

The I30 Series controlled environment chamber is typically provided with one or more power cords that must be plugged into electrical building services of appropriate type, rating and ampacity.



Always verify a chamber's electrical requirements against the provided electrical services prior to making final connections and energizing the unit.

A chamber's electrical requirements are listed on its serial tag, which is located inside the unit's door on the interior side wall of the controlled environment space. These electrical requirements include the operating voltage, phase(s) and maximum running load amperage (RLA) for the chamber, per the following requirements:

- Supply voltage must be within $\pm 10\%$ of the serial tag value.
- The number of phases provided should match the serial tag value.

- The electrical service must have a minimum circuit ampacity (MCA) sufficient to support the chamber's rated maximum running load amperage (RLA). Service MCA should ultimately be determined by local authorities having jurisdiction (AHJ), according to state, local and building electrical codes. As a rule of thumb, MCA can be estimated by the following equation:

$$MCA = 1.25 \times RLA_{max}$$

- The provided electrical service should not be smaller than the MCA. In many cases the service itself will be larger than the MCA. For example, a standard 30A electrical service might be specified to comply with a chamber's MCA requirement of 27A.



If a chamber is provided with multiple power cords, *each cord* will have its own RLA/MCA requirement. If both cords are to be connected on a single circuit with multiple receptacles, the service must be sized for the COMBINED RLA of both cords. An example equation is provided below for reference:

$$MCA_{combined} = 1.25 \times (RLA_{cord\ 1} + RLA_{cord\ 2})$$

In lieu of a single electrical service sized for multiple cords, connect each power cord to its own separate, dedicated electrical service.

Failure to follow the electrical service requirements outlined above can result in overloaded electrical services, tripped circuit protection on the supply and damage to facility and chamber electrical infrastructure such as wiring, plugs and receptacles.



Damage caused from incorrect or improperly sized electrical services is not covered under the manufacturer's warranty.



The duplex receptacle shown above can physically accommodate two 20A rated cords, but may not have sufficient capacity to supply power at the full rating of two cords, simultaneously. Verify the *combined* load the duplex receptacle's electrical service can safely support before plugging in multiple power cords.



Do not plug multiple chamber power cords into a duplex receptacle unless the circuit is dedicated and verified to have an MCA sufficient to support the combined RLA of both connected power cords.



Check quadplex receptacles for proper labelling indicating the presence of multiple circuits prior to plugging in multiple chamber power cords

Drainage and Plumbing Services

All base model I30 Series controlled environments reject condensed water from their evaporator coils. The amount of condensate is dependent upon a combination of controlled environment settings, ambient conditions, door opening frequency and duration, air exchange through (optional) fresh air ports, and characteristics of products placed inside the environment.

Optional relative humidity control systems increase the amount of condensate rejected from a given unit.

Whenever the evaporator coil operates at a temperature below the dew point inside the controlled environment, moisture present in the circulated air condenses onto the cooling coils. This condensate sheds off the coils, is routed through a drain and expelled out of the environment's floor drain.

Base model I30 Series incubators are provided with one 7/8 in ID (1 in OD) flexible drain line. Ideally, this drain line should be routed toward a floor drain close in proximity to the chamber to properly manage condensate rejected from the unit.

If the installation location for the chamber does not provide a nearby floor drain, the following drain accommodations can be considered:

- Extend the existing chamber drain tubing and route it to a floor drain that is farther away than the chamber's footprint.
- Place the existing drain tubing into a Q19 (External Drip Pan) optional equipment package.
- Connect the existing chamber drain system to a condensate pump



Please note that the standard drain system in an I30 Series controlled environment chamber works via gravity. Condensate will only drain properly if the facility drain is **lower** in elevation than the chamber floor drain and tubing.

Unpackaging

Inspect the Shipment



At the time of delivery, it is very important to verify that the proper quantity and type of products were received as per the Bill of Lading, and to inspect those products for shipping damage prior to accepting the shipment.

1. Carefully remove all packaging materials that surround the unit, ensuring no loose chamber components are accidentally discarded.
2. Visually inspect both the interior and exterior of the unit for dents, scratches or any other signs of damage
3. It is extremely important to note any damage on the shipping receipt so that corrective actions can be taken as efficiently and expeditiously as possible. The shipping documentation provides the following options:
 - a. Accept the shipment as-is
 - b. Accept the shipment with damages documented, understanding that corrective actions to rectify the damage will be performed onsite
 - c. Reject the shipment, where damage is sufficient to require the product to be returned to Percival, where corrective actions can be taken at the manufacturing facility

Remove the Chamber from its Skid



Warning! The I30 Series chamber is heavy. Please use caution when removing the unit from its shipping container and while moving it into position. These tasks should be undertaken with care by more than one person.

1. Remove shelving and any additional items packaged inside the chamber that can shift when the chamber is moved
2. If there is a drain line affixed to the shipping skid, free it and temporarily secure it to the chamber to prevent it from hindering movement of unit
3. Remove any metal shipping brackets that affix the chamber to the skid
4. Remove any bolts that affix the chamber to the skid
5. Lift the chamber off its shipping skid and place it upright onto a level surface

Moving the Chamber



Do not attempt to move any I30 Series chamber loaded with experiments, samples or other sensitive materials.



Warning! The I30 Series chamber is heavy. Please use caution while moving the unit. This task should be undertaken with care by more than one person.



Warning! Once removed from its skid, sliding the I30 Series into position may scratch the surface upon which the unit is placed.

Installation Guidelines

Once placed in a suitable location as prescribed in the preceding sections of this user manual, proceed with the following installation steps:

Level the Unit

Make sure the unit is placed upon a level surface to facilitate proper function and drainage. The base model I30 Series chamber is not provided with a means for levelling the unit on uneven or sloped surfaces. Levelling legs and casters are available as optional equipment that can be retrofitted onto the I30 Series chamber base. Please contact Percival's Customer Support team at customerservice@percival-scientific.com, or 1-800-695-2743.

Inspect the Control Box

While unplugged from electrical services, open the chamber's control panel and perform a visual inspection of the electrical components installed within it.

- Check the state of the resettable circuit breakers and reset any found in an 'open' state
- Check for any components that are not physically secured to the components mounting plate, control box housing or top of the insulated box.
- Check for any connector plugs that are dislodged or not fully seated into their receptacles and re-secure them as needed with a firm press.
- Check for any obviously loose or disconnected wiring



If any components have become dislodged or there is any question as to where a disconnected plug or wire should be connected, do not proceed any further with



chamber installation or operation and contact Percival's customer support team at 1-800-695-2743 or customerservice@percival-scientific.com

Install Condensate Drain Pan

The I30 Series chamber's evaporator coils are located on the back wall, inside the unit behind a removable access panel. As water condenses upon the evaporator coils it drips downward. A system of drip deflectors guide condensate into a drain pan, provided as standard equipment.

1. Locate the drain pan among the standard parts shipped inside of the chamber and remove any packaging materials
2. Place the drain pan on the floor, against the back wall of the chamber
3. The drain pan has a copper drain fitting which should be aligned with the chamber floor drain
4. Place the drain pan onto the chamber floor with the drain stub inserted into the chamber's floor drain.





Make sure the condensate drain pan is flush with the chamber floor and level. If not installed properly, condensate may collect directly onto the chamber floor, or may not drain out of the pan properly.

Install Shelving and Lights

All I30 Series controlled environment chambers are provided with steel wire shelving, which is shipped uninstalled and packaged within each chamber. To install shelving in an I30 Series base model chamber:

1. Unpackage each shelf and locate shelf hardware (pilaster clips)
2. Install pilaster clips:
 - a. Four clips, located at the same height are required to properly support each shelf
 - b. Numbers are embossed into each pilaster to assist with alignment of the clips
 - c. Insert the upper pilaster clip tab into the pilaster first
 - d. Twist the pilaster clip in a downward motion and insert the lower tab into the lower pilaster slot.



Note: It may be necessary to pinch the clip slightly, upon insertion, to obtain proper engagement of both clip tabs into the pilaster.

The image below shows an example of a properly installed pilaster clip:



3. Place shelves onto the installed pilaster clips, ensuring that the vertical tab on each clip sits inboard of the shelf frame, securing each shelf in place. When properly installed a shelf can only be removed by lifting it vertically off its clips.

The image below shows an example of a properly installed wire shelf:



For base model I30L Series incubators provided with IncuWhite™, please refer to the supplemental **IW User Manual** for instruction on the installation of horizontal lighting.

Connect Services

1. Plug the unit into properly sized electrical services, ensuring that all plugs are completely and securely inserted
2. Route the chamber's drains to a floor drain or other drainage accommodation
3. Connect services for optional equipment as directed in supplemental operation manuals (e.g. demineralized water, compressed gases, chilled water, ventilation ductwork, etc...)

Startup and Commissioning

Turn on the Chamber

Set the main power switch located on the left side of the control panel to the 'On' or 'I' position to energize the chamber. The IntellusUltra controller takes approximately 15-20 seconds to start up. Once the controller has started up, and there are no active alarm conditions, the rest of the chamber components will energize.

IntellusUltra Control System

The primary method of operating an I30 Series controlled environment chamber is through the C8 IntellusUltra control system's keypad overlay. The IntellusUltra overlay (shown below) is located on the exterior of the I30 Series base model's control panel.



Refer to the IntellusUltra Quick Guide provided with the chamber for basic instructions on the controller's operation. This guide can also be downloaded at <https://www.percival-scientific.com/wp-content/uploads/2023/03/IntellusUltra-Quick-Guide.pdf>



Refer to the **C8 Control System User Manual** for comprehensive operational instructions for the chamber's control system

If the primary control system user interface does not look like the image above, then the chamber is equipped with an optional touch screen user interface.



Please refer to the supplementary **Touch Screen User Manual** for instructions on the operation of this optional system.

When first energized the IntellusUltra control system is set to operate in Manual Mode, and has the following factory settings:

Control Feature	Factory Setting
System Time	Current North American Central Time Zone
Operation Mode	Manual
Programming Step Type	Non-ramping
Temperature Set Point	25°C
Temperature Limit 1 High Alarm	35°C
Temperature Limit 1 Low Alarm	-5°C
Temperature Limit 2 High Alarm	38°C
Temperature Limit 2 Low Alarm	-8°C
Light Output 1 (LL, VL and LLVL models)	0% (Off)
Light Output 2 (LLVL models)	0% (Off)

In general, any optional features controlled via the IntellusUltra are disabled by default. Please refer to the user manuals provided with optional equipment for information pertaining to their factory settings, setup and operation.

Calibration

All controlled environment chambers from Percival Scientific must pass rigorous quality checks and validation testing prior to shipment. As part of the validation process, all chamber control systems are calibrated against an NIST standard device at the following conditions:

Condition	Calibration
Temperature w/ Lights Off	25°C
Temperature w/ Lights On (for lighted models)	25°C
Relative Humidity w/ Lights Off (if RH option is equipped)	75%RH @ 25°C
Relative Humidity w/ Lights On (if RH option is equipped)	75%RH @ 25°C

At these calibration points, any discrepancy between an IntellusUltra sensor (located by the intake of the evaporator coil) reading and the NIST calibration standard (located in the center of the chamber environment) are entered into the control system as calibration offsets.

For any given environmental parameter controlled by the chamber:

$$\text{Calibration Offset} = \text{Calibration Standard Value} - \text{Control System Process Value}$$

For example, if the control system reads a temperature process value of 25°C and the calibration standard reads 24.5°C, then an offset of -0.5°C is saved into the controller. For each condition, the measured offset is applied to the process value so that it matches the calibration standard.

$$T_{Offset} = T_{Standard} - T_{Process Value}$$

$$T_{Offset} = 24.5^{\circ}C - 25.0^{\circ}C$$

$$T_{Offset} = -0.5^{\circ}C$$

Any offsets with lights turned off are called Night Offsets and any offsets with any amount of lights turned on are called Day Offsets.



Please refer to the provided control system user manual for additional information regarding calibration offsets.



Factory calibration offsets serve as suitable values for general chamber use.

Consider recalibrating the chamber if precise environmental control is required at specific conditions that are significantly different than the factory calibration points.

Operation

Guidelines for Loading a Chamber

When placing products, specimens or experiments onto shelves inside an I30 Series controlled environment, adhere to the following guidelines to ensure the unit operates at peak performance:

- For best temperature uniformity, evenly distribute items throughout the chamber space and allow space between items to promote proper air flow
- As a good rule of thumb, do not populate more than 80% of any shelf's surface area
- Do not place more than 125 lbs (56.8 kg) onto any shelf
- Do not place more than 500 lbs (227.3 kg) total in a chamber model



Avoid placing items in a unit that produce significant amounts of heat. I30 Series base model chambers are designed to accommodate a product heat load of 2 W/ft² of shelf space. Any heat introduced into the chamber environment beyond this amount can result in loss of environmental control.

Running a Control Profile

1. Close the main chamber door, ensuring a proper seal between the door gasket and insulated box
2. Configure static or multi-step profile process value set points
3. Check alarm limits, ensuring that they are set above the maximum and below the minimum process values. Limits should not be set closer than 2-3°C above or below the operational range of the entire control profile.
4. Select the mode of operation on the control system (e.g. Manual, Diurnal, Program or Sequence).

Once an operating mode is set, the IntellusUltra control system automatically executes any set points specified in the profile.

If an alarm threshold is exceeded, the controller produces an audible alarm until the alarm is acknowledged by the user. The alarm state remains active until the source of the alarm is resolved. A temperature alarm condition shuts down all chamber sub-systems inside the environment until the alarm state is cleared. Whenever process values fall back within allowable limits, the control system automatically reverts to normal operation, requiring no involvement from the user.

The IntellusUltra controller has an internal battery which allows it to keep time in the event of a power cycle or outage. Upon power up, the chamber will resume the previously executed control profile.

- Control is resumed around static process value set points when the controller is in manual mode
- When executing a multi-step program, the controller resumes control around the current program step as determined by the controller system time.
- When executing a sequence of programs, the controller resumes control around the current program iteration and step as determined by the system time unless power is off at 12:00 am. If power is off at 12:00am the program iteration count will not be incremented.



For best control, minimize the frequency and duration of chamber door openings.

Maintenance

Performing regular maintenance on an environmental chamber reduces performance degradation, improves reliability and extends operational life. In addition to any user-specific maintenance protocols, the following general maintenance tasks should be performed at the recommended intervals.



Turn chamber power off prior to performing any maintenance inside the environment.



Unplug or disconnect chamber supply power prior to performing any maintenance inside the chamber's mechanical compartment or control box.

General Maintenance Summary Table

Maintenance Task	Recommended Interval Schedule
Clean the Chamber	Every 3 months, or as needed
Clean the Condenser	Every 3 months, or as needed
Clean the Evaporator	Every 12 months

Cleaning the Chamber

Wipe down all interior and exterior surfaces with a solution of water and mild detergent. Do not use abrasive agents or cleaning pads as these could scratch surfaces.

Glass cleaners can be used on stainless steel surfaces to prevent streaking.

Clean the Heat Exchangers

Air must pass freely through the evaporator and condenser for proper performance. Ambient air is drawn into and forced through the condenser by the condensing unit fan. Chamber process air is drawn into and forced through the evaporator by a bank of fans inside the evaporator cover. In both cases, the fans run continuously while the chamber is in operation and there are no active alarms.



Power down the chamber prior to any cleaning effort on refrigeration system components.

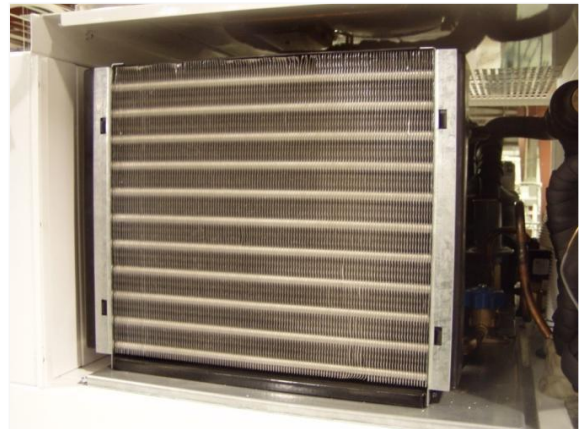


Please be aware that some parts of the condensing unit become hot while the unit is in operation and can remain hot for some time after the unit is powered down.

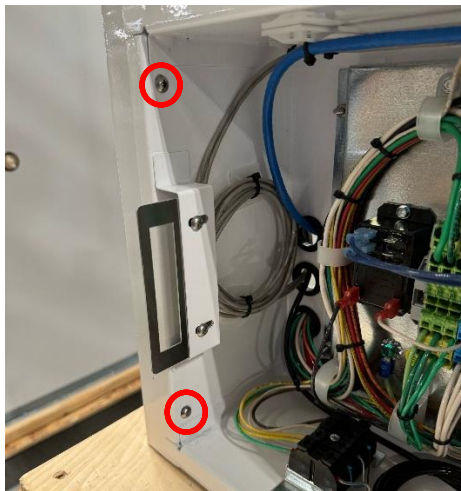
Clean the Condenser

Once powered down, remove any dust or debris collected upon the condenser fins, copper tubing, fan blades and motor. Blow dust out of the condenser from behind with compressed air, a brush, or vacuum and wipe dust from the fan blades.

To access the condenser coil, remove the vented side cover panels on the unit's mechanical section.



To access the condenser fan, remove the vented side and rear cover panels on the unit's mechanical section. If necessary, the chamber's control box can be removed from the mechanical section. Remove the machine screws securing the control box in place and slide the unit away from the mechanical section. There is sufficient wiring to allow access to mechanical components from the front of the unit without the need to disconnect any wire looms.



(Remove inner machine screws and top hinge screws for control box removal)

Clean the Evaporator

Once the unit is powered down, remove the evaporator cover to access the evaporator coil and air circulation fans.

1. Unplug any lights or auxiliary equipment plugged into the chamber's receptacle panel
2. Remove all shelving. Clips can often be left in place.
3. Remove the sheet metal screws that secure the evaporator cover to inner rear wall of the insulated box

A picture of the exposed evaporator coil is shown below for reference:



Clean the evaporator coil by dislodging dirt and debris via soft brush, compressed air or vacuum, and inspect the condensate drain pan for any cracks or blockages.

Remove dust and debris from the evaporator fans and wipe any dirt or residue from inside the evaporator cover, housing, and drain pan.

Troubleshooting

Loss of Temperature Control – General

Possible Reason	Solution
Improper or incorrect signal between controller and control relay(s)	Check for ~5VDC output signal between the controller and solid-state relay. Output state is indicated by LEDs on the controller overlay. Contact factory if insufficient output voltage from the control system
Temperature sensor	Check the sensor for correct output signal. Refer to the RTD temperature vs. resistance table in the controller manual. Contact factory if sensor output does not match the table values.
Solid-state relays	If correct trigger voltage is correct to the relay coil, check for the correct output voltage through the relay. Refer to the chamber's electrical schematic for the VAC output to the affected heating and/or cooling device(s)
Hot gas solenoid valve	When in heating mode, the hot gas solenoid should be in the open position allowing hot gas to flow into the evaporator coil. Check the solenoid valve for proper actuation and the valve body for internal blockages.
Liquid line solenoid valve	When in cooling mode, the liquid line solenoid valve should be in the open position, allowing liquid refrigerant to flow into the thermal expansion device(s). Check the solenoid for proper actuation and the valve body for internal blockages.

Loss of Temperature Control - Overheating

Loss of refrigerant	Check system pressures and check for leaks with a leak detector. Evacuate the system, repair leak(s) and recharge the system. Refer to the unit's refrigeration diagram and serial label.
Restriction in the refrigeration piping or componentry	If adequate pressure and no leaks, there may be a restriction in the unit's liquid line solenoid valve, filter/drier or thermal expansion device. Check the line temperature directly before and after each device. There may be a blockage if the outlet is colder than the inlet to the solenoid and drier.
Insufficient heat exchange through the condenser	Check the ambient air temperature is below 90°F. Make sure the condenser fan and coils are clean. Make sure the condenser fan is running.
Compressor motor fails to pump refrigerant throughout the system	Check electrical power to the motor and start components. Perform an ohm check on the motor windings. Check high-side system pressure if the unit runs
Insufficient heat exchange through the evaporator	Check for proper fan operation. Fans should be continuously running, drawing air into the evaporator. Make sure the evaporator coils are clean.

Loss of Temperature Control – Overcooling

Electric heater malfunction	Check output voltage from the controller to the heater relay. Check output voltage from the heater relay to the heater element. Check the circuit breaker in the heater electrical circuit.
Malfunctioning hot gas solid-state relay (capillary tube systems)	Check output voltage from the controller to the hot gas line solenoid valve. Check voltage between the relay and solenoid valve. The solenoid valve should be open whenever the 'heat' LED is lit
Malfunctioning liquid solid-state relay (TXV systems)	Check output voltage between controller and relay. Check voltage between relay and solenoid. The solenoid should fully close when the 'heat' LED indicator light is energized.
Blocked hot gas solenoid valve (capillary tube systems)	If the hot gas solenoid valve gets blocked, then flow will divert through the capillary tube, causing the system to cool even when calling for heat.

General

Chamber does not power on	Check facility electrical services and circuit breakers. Check that the chamber is properly plugged into the facility services. Check circuit breakers inside the unit's control box.
Individual chamber component does not turn on	Check controller settings and verify that the device has been properly enabled. Check the control box for tripped circuit breakers.
Condensation	The amount of condensation that can form inside and be rejected from a controlled environment can fluctuate, and is highly dependent upon ambient conditions, interior environmental conditions, fresh air exchange through (optional) fresh air ports, frequency of door openings, product load and optional humidity control systems. Minimize door openings and the amount of moisture present inside the unit, and close the access port

Parts and Service

Replacement parts can be ordered from Percival Scientific at:

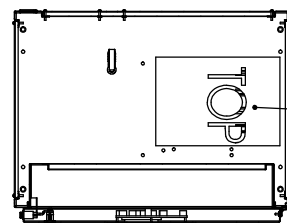
Ph: 1-800-695-2743

Email: parts@percival-scientific.com

For additional questions regarding this product, please contact Percival's customer support team at:

Phone: 1-800-695-2743

Email: customerservice@percival-scientific.com

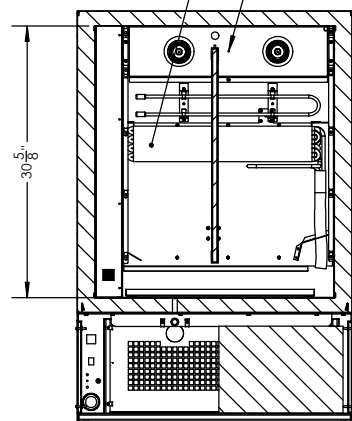


SECTION C-C
SCALE 1 : 14

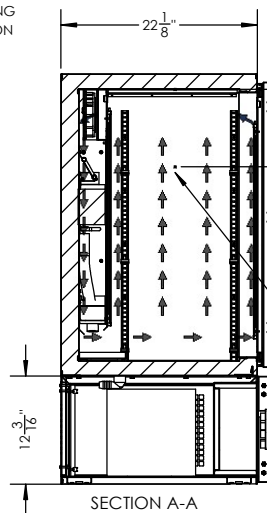
AIR COOLED
COND. UNIT

DOOR OPENING
29 1/8"

EVAPORATOR COIL
TEMPERATURE
AND (OPTIONAL)
HUMIDITY PROBE
MOUNTING
LOCATION



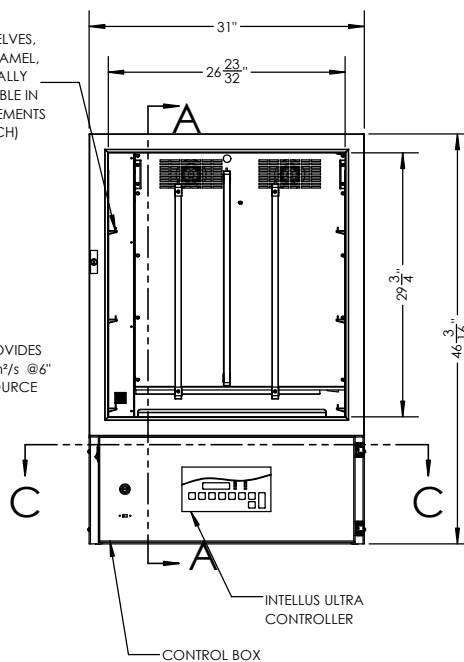
SECTION B-B
SCALE 1 : 14



SECTION A-A
SCALE 1 : 14

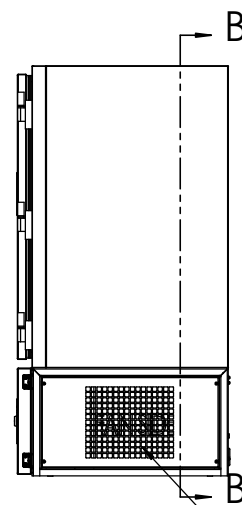
WIRE SHELVES,
WHITE ENAMEL,
VERTICALLY
ADJUSTABLE IN
1/2" INCREMENTS
(3 EACH)

LAMP PROVIDES
125 $\mu\text{mol}/\text{m}^2/\text{s}$ @ 6"
FROM SOURCE



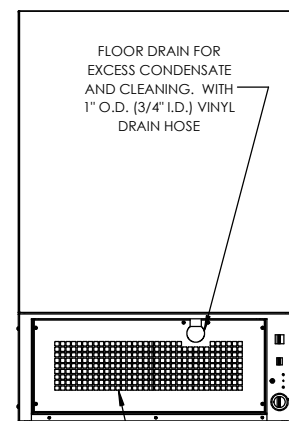
CONTROL BOX

INTELLUS ULTRA
CONTROLLER



B

B



FLOOR DRAIN FOR
EXCESS CONDENSATE
AND CLEANING. WITH
1" O.D. (3/4" I.D.) VINYL
DRAIN HOSE

POWER
CORD

AIR INTAKE
MINIMUM 6" CLEARANCE
REQUIRED

AIR EXHAUST
FROM MECHANICAL
COMPARTMENT ALLOW
MINIMUM 6" CLEARANCE

ELECTRICAL REQUIREMENTS:

PROVIDED WITH (1) 230VAC, H05W-F, 16A, POWER CORD
CORD #1: 3.9A (4.9A RLA)

HEAT REJECTION TO AMBIENT:
1,442 Btuh (424W)

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DRAWING IS THE SOLE PROPERTY OF
PERCIVAL SCIENTIFIC, INC.. ANY
REPRODUCTION IN PART OR AS A WHOLE
WITHOUT THE WRITTEN PERMISSION OF
PERCIVAL SCIENTIFIC, INC. IS PROHIBITED.

 **PERCIVAL SCIENTIFIC, INC.**
PERRY, IOWA

TITLE: GENERAL ASSEMBLY

REV: R1

DRAWING: 035909-10

PART BY: DGK

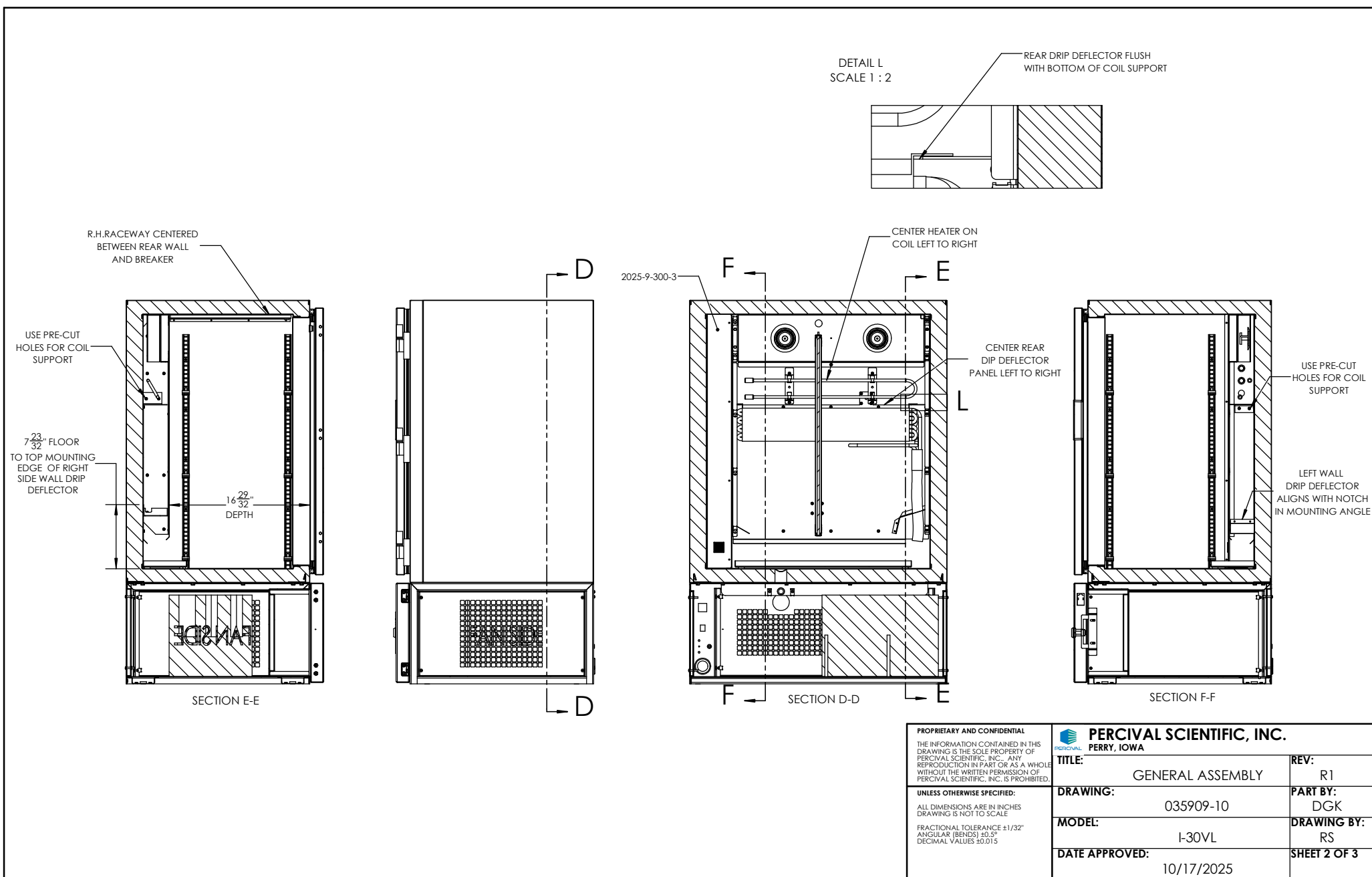
MODEL: I-30VL

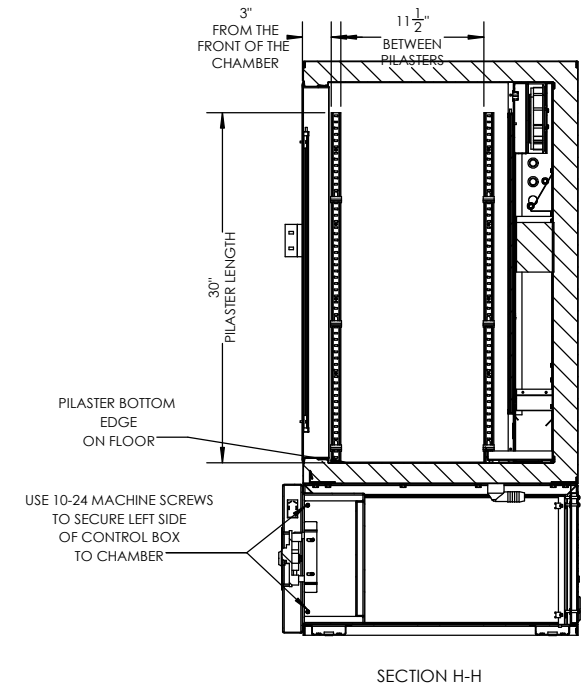
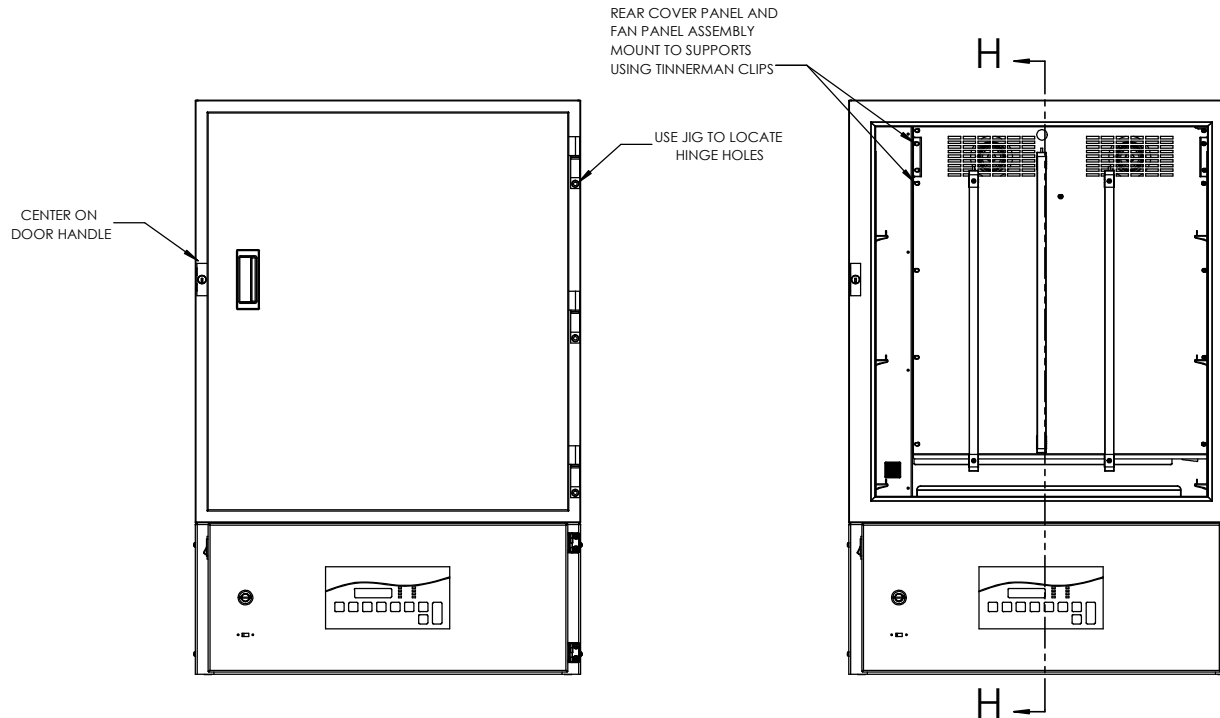
DRAWING BY: RS

DATE APPROVED: 10/17/2025

SHEET 1 OF 3

UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS ARE IN INCHES
DRAWING IS NOT TO SCALE
FRACTIONAL TOLERANCE $\pm 1/32"$
ANGULAR (BENDS) $\pm 0.5^\circ$
DECIMAL VALUES ± 0.015



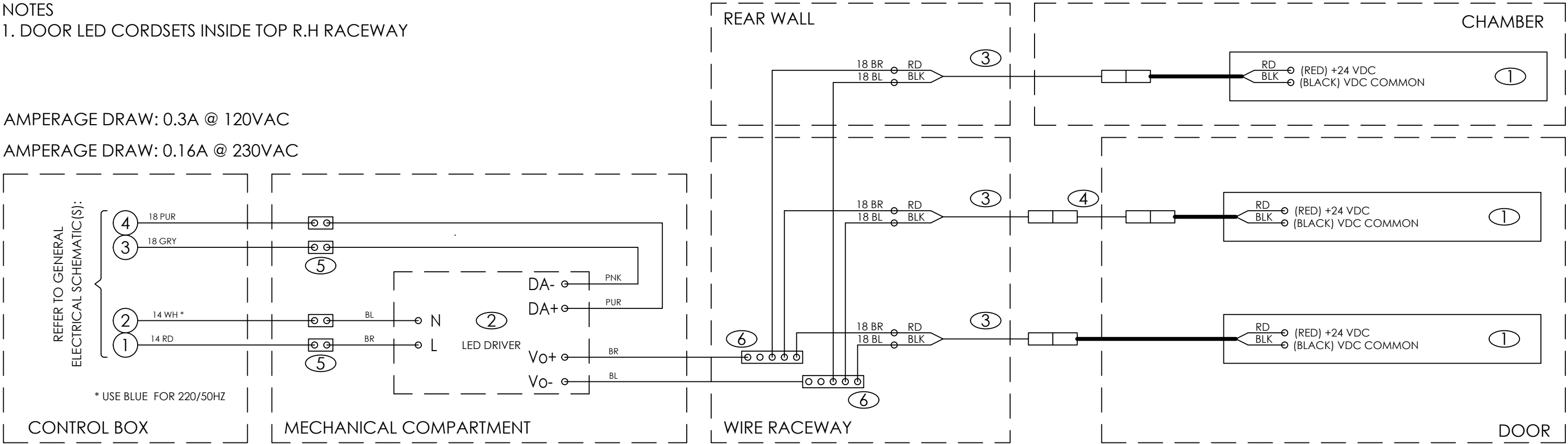


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PERCIVAL SCIENTIFIC, INC. PERRY, IOWA		
TITLE:	GENERAL ASSEMBLY	REV: R1
DRAWING:	035909-10	PART BY: DGK
MODEL:	I-30VL	DRAWING BY: RS
DATE APPROVED:	10/17/2025	SHEET 3 OF 3



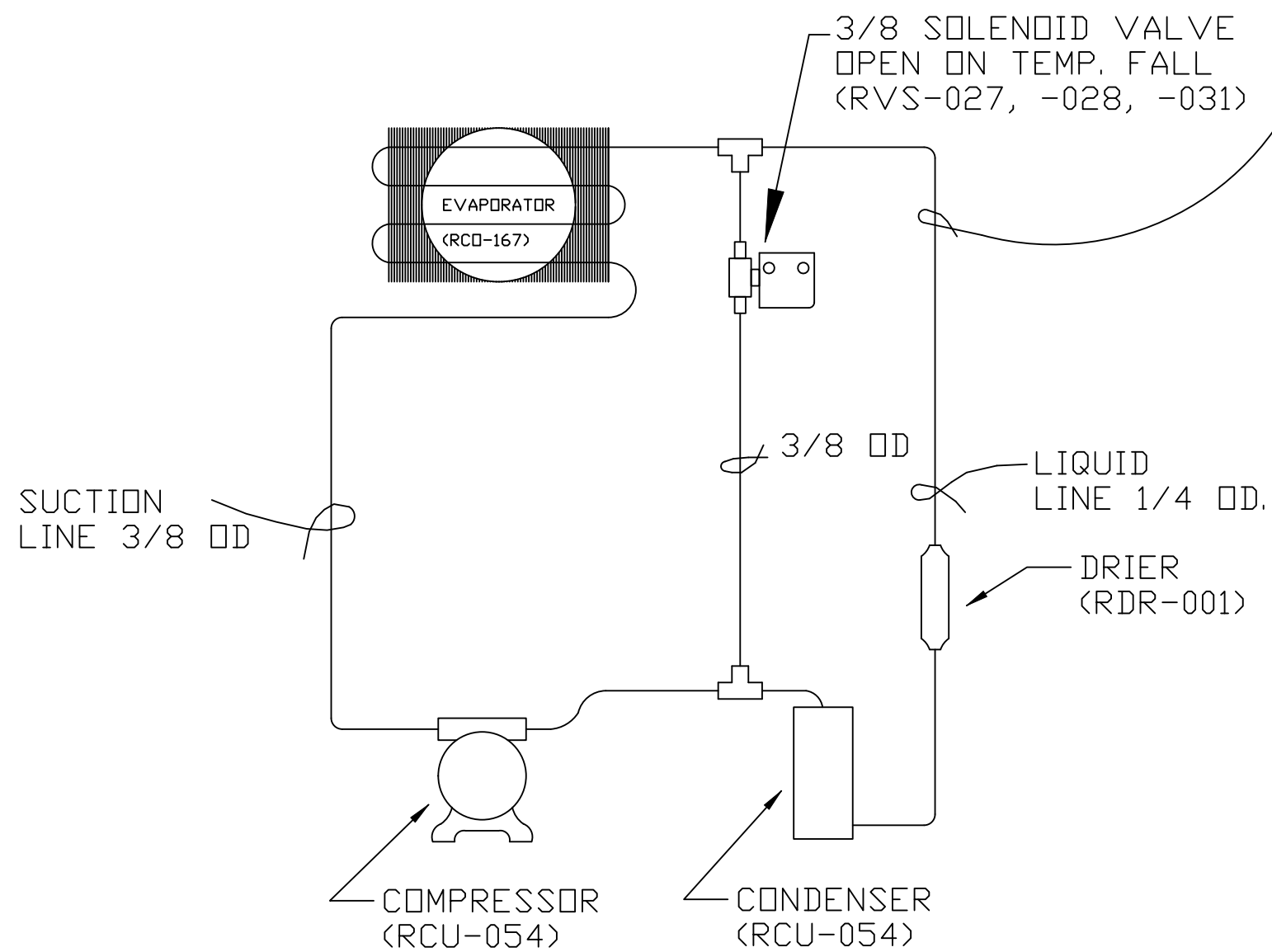
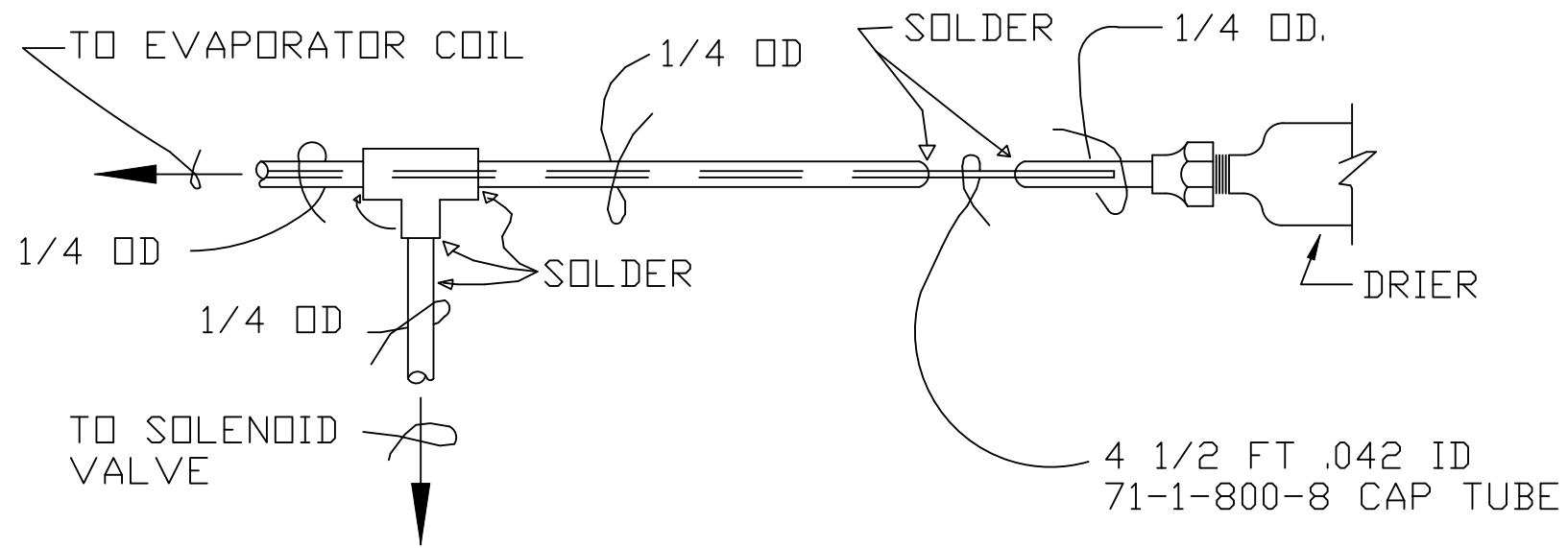
NOTES
1. DOOR LED CORDSETS INSIDE TOP R.H RACEWAY

AMPERAGE DRAW: 0.3A @ 120VAC
AMPERAGE DRAW: 0.16A @ 230VAC



- BOM:
- 1 - LED MODULE - 24" LENGTH, DIMMABLE, WHITE, 24 VDC, 5700K (ELD-106)
 - 2 - LED DRIVER - 100-240, 277V INPUT, 24VDC OUTPUT, 50-60Hz, 120W (ELD-117)
 - 3 - LED FEMALE RECEPTACLE CONNECTOR (ELD-113)
 - 4 - LED FEMALE TO MALE CONNECTOR (ELD-164)
 - 5 - LEVER CONNECTOR - 2 TERMINAL, 24-12 GA WIRE, 600V, 20A (ECO-119)
 - 6 - LEVER CONNECTOR - 5 TERMINAL, 24-12 GA WIRE, 600V, 20A (ECO-121)

 PERCIVAL SCIENTIFIC, INC.			
TITLE: ELECTRICAL SCHEMATIC - GENERAL LIGHTING			
MODEL: I-30VL		DRAWING:	
BY: RAS	DATE: 10/17/25	2025-9-0-2	
		REV:	-



REFRIGERANT: R-513A
9 OZ. (RGE-010)

 PERCIVAL SCIENTIFIC, INC.			
TITLE: REFRIGERATION SCHEMATIC - GENERAL			
MODEL: I-30VL		DRAWING:	REV:
BY: RAS	DATE: 10/16/25	035909-1-1	-



IW - IncuWhite™ LED Lighting

Operator's Manual

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Introduction

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**Please read this manual
carefully before proceeding
with operation**

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Rev A	8/15/2024	Initial Release

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Warranty Information

Equipment Limited Warranty

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- Percival reserves the right to inspect the equipment after a warranty claim is made to determine the proper course of corrective action

Exclusions

- Parts or elements damaged from improper installation, including mechanical, electrical and plumbing services, IT infrastructure, inadequate room ventilation, improper water quality, and ambient conditions that are out of specification
- Parts or elements damaged from improper operation
- Parts or elements damaged from improper maintenance
- Parts or elements considered to be consumable, that outlive their normal expected terms of usefulness, such as: light bulbs, filters, desiccant material and CO₂ scrubbing media
- Damage resulting from shipment to or relocation within the customer's facility after equipment has been signed for and ownership is transferred to the customer
- Modification to equipment by the customer without Percival's consent may void this warranty
- Repair work undertaken without prior consent of Percival may void this warranty
- Damage caused by accident, fire, Force Majeure or Acts of God

Additional Terms

- This warranty is in lieu of any other warranties, expressed or implied, including merchantability or fitness for a particular purpose
- Warranty terms described herein cannot be changed without the expressed, written consent from Percival
- The owner agrees that Percival's sole liability with respect to defective parts or materials shall be set forth in this warranty, and any claims for incidental or consequential damages are expressly excluded
- This warranty is non-transferable and applies only to the original purchaser
- Repaired or replaced parts shall be warranted only for the unexpired portion of the original warranty, unless otherwise defined
- Parts replaced under warranty shall become the property of Percival

To Make a Warranty Claim

1. Document the issue with detailed notes and photographs along with the equipment's serial number
2. Contact Percival's customer support team at customerservice@percival-scientific.com, parts@percival-scientific.com or 1-800-695-2743
3. Once your claim is received, our customer support team will review it and contact you with further instructions

Definitions

LED – Light Emitting Diode

‘Lamp bank’, ‘Light fixture’, ‘Fixture’ and ‘Lights’ are used interchangeably in this manual to describe the IncuWhite™ LED lighting system.

Light output in this manual is measured in $\mu\text{mol}/\text{m}^2/\text{s}$ and published output data was collected at 6 in (15.2 cm) from the source in an operating environment of 25°C

General

LED lighting has become increasingly popular in controlled environment chambers due to overall system-level performance gains that can be realized from their use. Compared to conventional light sources (e.g. fluorescent, incandescent and HID), LEDs are more energy efficient, have higher durability, longer life, and offer improved controllability and tunability. LEDs can be tailored to deliver the specific quantity and quality of light required for simulating diurnal photoperiods and promoting optimal growth conditions for plants, microorganisms, and cell cultures.

LEDs introduce less heat into a controlled environment, which reduces demand on the unit’s cooling system and facilitates the stable control of critical process parameters. The net effect is improved experimental efficacy, greater reproducibility, and reduced operational costs.

The IW (IncuWhite™ LED Lighting) option provides an LED lighting system designed specifically for use in Percival Scientific controlled environment chambers with low to medium light intensity requirements, such as biological incubators.

Construction

IncuWhite™ LEDs are offered in 24” (61 cm) and 48” (122 cm) length form factors. Both lengths share a common design where the LED circuit board(s) are affixed to an aluminum extrusion. This extrusion is used for strength as well as heat dissipation. Plastic caps with rubber seals and a light dispersing protective cover provide additional protection up to an IP65 rating for the product.

Mounting

The IncuWhite™ LED modules' aluminum housing snaps into various retainer clips, allowing for vertical or horizontal orientation upon a flat surface or wire shelf.

Technical Specifications

24 in IncuWhite™

Length: 24 in (61 cm)

Voltage: 24 VDC

Wattage: 12W (each)

Intensity: $\sim 30 \mu\text{mol}/\text{m}^2/\text{s}$ at 6in (15.2cm) from the source

CCT = 5700K

CRI = 90

Control Range: 5 – 100% output

48 in IncuWhite™

Length: 48in (122 cm)

Voltage: 24 VDC

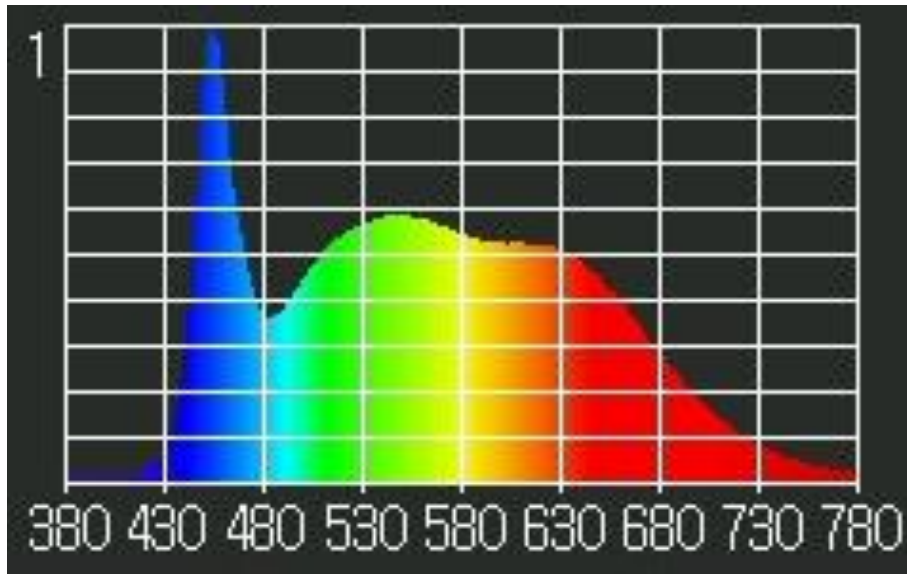
Wattage: 24W (each)

Intensity: $\sim 60 \mu\text{mol}/\text{m}^2/\text{s}$ at 6in (15.2cm) from the source

CCT = 5700K

CRI = 90

Control Range: 5 – 100% output

IncuWhite™ spectral output:**Installation****Incubators (I Series)**

IncuWhite™ LEDs are the standard lighting system utilized in Percival Scientific's line of biological incubators.

Vertical Lighting

Vertical lighting (included on all incubator model numbers with a 'VL' designation) ships pre-installed from Percival's factory and requires no installation by the User.

Horizontal Lighting

Horizontal lighting (included on all incubator model numbers with an 'LL' designation) is affixed to the underside of the unit's wire shelving, which is shipped uninstalled from Percival's factory. To install horizontal lights on 'LL' models:

- 1) Unpackage each shelf and locate shelf hardware (pilaster clips)
- 2) Install pilaster clips:
 - a. Four clips, located at the same height are required to properly support each shelf

- b. Numbers are embossed into each pilaster to assist with alignment of the clips
- c. Insert the upper pilaster clip tab into the pilaster first
- d. Twist the pilaster clip in a downward motion and insert the lower tab into the lower pilaster slot.



Note: It may be necessary to pinch the clip slightly to obtain proper engagement of both clip tabs into the pilaster.

The image below shows an example of a properly installed pilaster clip:



- 3) Place shelves onto the installed pilaster clips, ensuring that the vertical tab on each clip sits inboard of the shelf frame and secures each shelf from sliding off any clip. When properly installed a shelf can only be removed by lifting it vertically off its clips.

The image below shows an example of a properly installed wire shelf:



- 4) If a shelf has pre-installed IncuWhite™ LED modules, make sure to orient the assembly such that power cords extend toward the back wall of the controlled environment, or are close in proximity with the chamber's corresponding receptacle cords.

The image below shows an example of proper shelf and light orientation:



Ensure chamber power is turned off, prior to plugging in LEDs

- 5) Insert the male power plug of each IncuWhite™ LED module into its corresponding female receptacle. The connector pair is keyed such that they can only be connected in one orientation.

The images below show the plug and receptacle pair, and their proper, full engagement:



Operation

IncuWhite™ LEDs are controlled through open-loop dimmable light outputs via the chamber's IntellusUltra control system. This control scenario allows the user to set lighting output level(s) as a percentage of total output. For example, a set point of 100% will energize the associated LED modules to their maximum output and a set point of 50% will reduce light output to half of their maximum output.

IncuWhite™ LEDs are dimmable in 1% increments between 5 – 100% output.

Any set point less than 5% will de-energize the light output and turn off the associated lighting circuit(s).

The factory default setting for any IncuWhite lighting system is Off.

To operate the IncuWhite™ LEDs:

- 1) Ensure the lights are installed according to the guidelines outlined above
- 2) Set the desired light output level as either a Manual or Programmed set point



Please refer to the control system user manual for specific instructions on this process.

Upon entry of any new light output setting(s), the chamber's control system sends a command signal to the associated light circuit(s), causing their power output to change.



The update frequency between the control system and downstream LED control devices is once per minute, or upon any saved setting change through the controller. In certain circumstances, light output may not immediately correspond to controller settings after a power cycle for up to one minute.



Please note that whenever any light is turned on through the control system, Day Calibration Offsets are applied to the Temperature and Relative Humidity (if equipped) process control loops. During the transition between lights on to off (or vice versa), some fluctuations in process control are possible.

Maintenance



IncuWhite LED modules require minimal maintenance. Inspect and clean lights in the same manner and on the same schedule as described in the base chamber user manual.

The IntellusUltra control system keeps track of the total hours the IncuWhite™ LED lighting system is in operation over time and notifies the user when the lighting system has reached its average rated life (ARL). When the controller's Light Lifetime Alarm threshold has been reached, it is recommended that the system's light output be measured with a quantum sensor and checked against the chamber's original light intensity specification(s).



Please refer to the IntellusUltra control system user manual for specific instructions regarding Light Lifetime Alarms

Troubleshooting

Problem	Reason	Solution
Lights don't turn on	Problem with power cords	Check to make sure LED modules are plugged in properly and plug/receptacle pairs are fully seated
	Electrical issue – tripped circuit breaker	Check status of circuit breaker in control box and reset as needed
	Electrical Issue – power circuit (relay(s), LED driver(s))	Contact customer support
Lights don't turn off	Control Issue – disconnected, or incorrect control signal	Cycle chamber power. If problem persists, contact customer support
Lights don't dim	LED driver malfunction	Cycle chamber power. If problem persists, contact customer support

Parts and Service

Replacement parts can be ordered from Percival Scientific at:

Ph: 1-800-695-2743

Email: parts@percival-scientific.com

For additional questions regarding this product, please contact Percival's customer support team at:

Phone: 1-800-695-2743

Email: customerservice@percival-scientific.com

Please have your chamber serial number available for faster and more efficient customer service.



Q23/Q23+ – Open-loop Dimmable Lighting Control

Percival Model: **Various**

Specification Document: **Q23 & Q23+**

505 Research Drive • Perry, Iowa 50220
Toll-free 800.695.2743 • 515.465.9363 • fax 515.465.9464
www.percival-scientific.com

- 1.1. The Q23 option adds the capability to control lighting in a dimmable manner
- 1.2. The Q23+ option adds the capability for multiple tiers of lighting to be independently dimmable
- 1.3. Q23 and Q23+ dimming is accomplished via an open-loop control scenario where light output is controlled as a percentage of total output
- 1.4. Dimmable lighting control options can only control lighting systems that are dimmable, and compatible with the Intellus control system's dimmable control outputs

2. Performance

- 2.1. All standard LED lighting systems by Percival are natively dimmable
- 2.2. Some devices cannot be controlled through the entire 0 – 100% output range, as they can become unstable or unresponsive at low % output settings. In these cases, the lighting devices must be turned off below the low % output threshold.
- 2.3. Any time lights are turned on:
 - 2.3.1. Day offset shall be applied via the controller
 - 2.3.2. The light lifetime begins to accrue

3. System Hardware

- 3.1. Technical Specifications:
 - 3.1.1. Dimmable control signal types
 - 3.1.1.1. DALI
 - 3.1.1.2. PWM
 - 3.1.1.3. Analog, VDC

4. Maintenance

- 4.1. No specific maintenance requirements are associated with these options codes

5. Additional Notes

- 5.1. [Add notes here]



Q9 – Phenolic Coated Evaporator Coils

Operator's Manual

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Introduction

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- Repair work undertaken without prior consent of Percival may void this warranty
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Definitions

General

Some applications (such as drosophila and marine) can create conditions inside environmental chambers that are corrosive to copper over time.

The Q9 (Phenolic Coated Evaporate Coils) option provides improved corrosion resistance for refrigeration components housed inside a Percival environmental chamber. Corrosion resistance is achieved through the application of a special phenolic epoxy coating applied to all susceptible refrigeration components inside the controlled environment

In addition to the coating on the standard evaporator coils, it is also applied to dehumidifying evaporator coils, copper refrigeration lines inside the chamber, and thermal expansion valves.

Location

Phenolic coated refrigeration components are installed in the same method and location as standard equipment. Prior to installation, the phenolic coating is applied to susceptible parts.

Operation

Phenolic coating does not change the refrigeration system's operation. Refrigeration system performance is only minimally changed. Coated evaporator coils are estimated to have approximately 1% less capacity than an uncoated system.

Maintenance



It is recommended to clean and inspect the evaporator coils at least once every 12 months. In extremely dirty environments, cleaning intervals should be reduced to every 3 months (four (4) times per year).



Refer to the chamber's operation manual for general guidance on refrigeration system maintenance, and how to access the evaporator coils for service.

Coated coils and copper lines must be cleaned according to the following guidelines:

- 1) Flush the coil with water to rinse loose residue. Allow the system to soak for 10-20 minutes to help dissolve or loosen any surface residue.
- 2) Use an acceptable cleaner, such as:
 - a. Liquid soap detergent and warm water
 - b. Lysol
 - c. Pine-Sol
 - d. Pine oil or other terpene-based cleaners
- 3) Flush unit with cleaner thoroughly until all signs of residue are eliminated
- 4) Rinse with clean water
- 5) Allow the unit to dry completely prior to turning on power and putting the unit back into service

Avoid:

- 1) Spraying water or cleaning agents onto any components, other than the desired cleaning area. Electrical components inside the controlled environment could sustain damage.
- 2) Using water under high pressure
- 3) Abrasive products to scour or remove dirt
- 4) Striking the coil with a tool to dislodge or remove soil or residue
- 5) Corrosive, caustic or alkaline cleaners (with a pH < 5.5 or > 8.5)

Damage from improper cleaning may void the warranty.

Troubleshooting

Temperature control problems stemming from loss of refrigerant charge can result from problems with the phenolic coating. If there is suspicion the phenolic coating has been compromised, perform a visual inspection (where possible) of coated components.

Conduct a leak detection test to assess areas of the coated components that cannot be visually inspected.

Parts and Service

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Email: parts@percival-scientific.com

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Email: customerservice@percival-scientific.com

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Q4 – Door Lock

Operator's Manual

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Warranty Coverage

- Coverage period shall be twenty-four (24) months from the date of delivery
- Percival's obligation under this warranty is limited to the repair or replacement of defect at no charge for parts, shipping and labor
- Percival reserves the right to inspect the equipment after a warranty claim is made in order to determine the proper course of corrective action

Exclusions

- Parts or elements damaged from improper installation, including mechanical, electrical and plumbing services, IT infrastructure, inadequate room ventilation, improper water quality, and ambient conditions that are out of specification
- Parts or elements damaged from improper operation
- Parts or elements damaged from improper maintenance
- Parts or elements considered to be consumable, that outlive their normal expected terms of usefulness, such as: light bulbs, filters, desiccant material and CO₂ scrubbing media
- Damage resulting from shipment to or relocation within the customer's facility after equipment has been signed for and ownership is transferred to the customer
- Modification to equipment by the customer without Percival's consent may void this warranty
- Repair work undertaken without prior consent of Percival may void this warranty
- Damage caused by accident, fire, Force Majeure or Acts of God

Additional Terms

- This warranty is in lieu of any other warranties, expressed or implied, including merchantability or fitness for a particular purpose
- Warranty terms described herein cannot be changed without the expressed, written consent from Percival
- The owner agrees that Percival's sole liability with respect to defective parts or materials shall be set forth in this warranty, and any claims for incidental or consequential damages are expressly excluded
- This warranty is non-transferable and applies only to the original purchaser
- Repaired or replaced parts shall be warranted only for the unexpired portion of the original warranty, unless otherwise defined
- Parts replaced under warranty shall become the property of Percival

To Make a Warranty Claim

1. Document the issue with detailed notes and photographs along with the equipment's serial number
2. Contact Percival's customer support team at customerservice@percival-scientific.com, parts@percival-scientific.com or 1-800-695-2743
3. Once your claim is received, our customer support team will review it and contact you with further instructions

Definitions

General

Door locks are available so the environmental chamber's door(s) can be manually locked by the user.

The Q4 (Door Lock) option provides a keyed security lock for each door.

Each lock is provided with two keys. These are common keys that will lock and unlock all the locks on a chamber.

Location

Locks are placed on the front of the chamber at a height that is easily accessible for a user of average height.

Installation



Keys can be found inside the chamber, included with the other chamber accessories and uninstalled parts.

Operation

The locks are 1/4 turn to lock and unlock.

Maintenance



These durable locks require no specific washing procedure other than to inspect the lock and keep clean of any debris that will prevent insertion of the key. Over time, lubrication of the lock may be needed.

Troubleshooting



Alignment between the lock and strike is set at the factory. Misalignment between the lock and strike can occur if the environmental chamber is not properly levelled at the time of installation. Door hardware can also loosen with use over time, contributing to lock misalignment.

Parts and Service

Replacement parts can be ordered from Percival Scientific at:

Ph: 1-800-695-2743

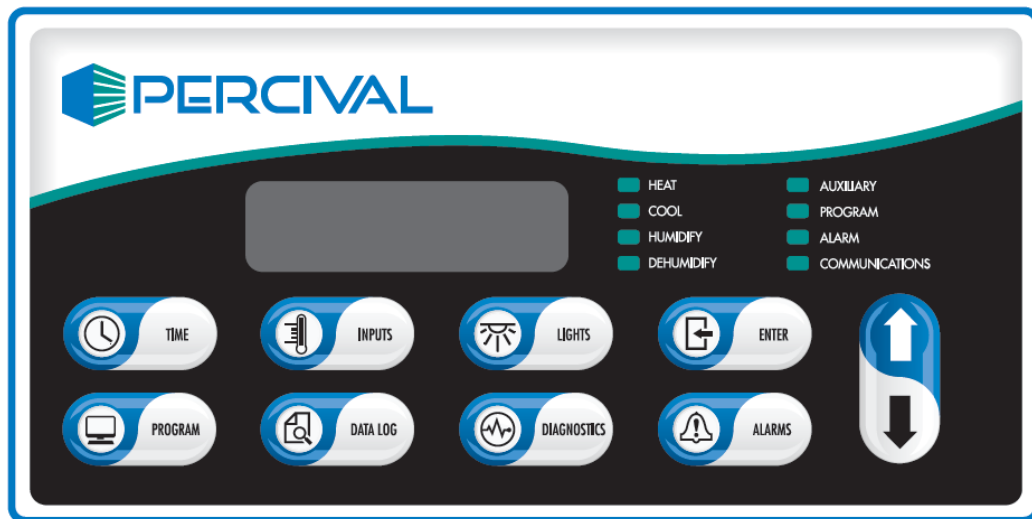
Email: parts@percival-scientific.com

For additional questions regarding this product, please contact Percival's customer support team at:

Phone: 1-800-695-2743

Email: customerservice@percival-scientific.com

Please have your chamber serial number available for faster and more efficient customer service.



IntellusUltra & IntelliusUltraConnect Controller Manual

WARNING

The controller should always be put into manual mode before changing the controller time. Changing the system time while running a program or sequence can cause unpredictable results to occur. Please refer to the section titled “Running Manual Settings” for information on setting the controller to operate in Manual mode.

Program operation will be suspended when running Manual settings. Make sure to note what style of program is running and where the program or sequence is currently executing before running Manual settings. See the “Status Menu” section for information on checking program execution status. Once the system time is set, the previously-running Program or Sequence can be resumed.

Please plan for Daylight Saving Time changes in your programming strategy, as the controller system time does not automatically adjust.

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Introduction

Please feel free to contact Percival Scientific with any questions you may have about this manual or using the IntellusUltra controller by calling 1-800-695-2743 or 515-465-9363 or by sending e-mail to service@percival-scientific.com.

How to Use the Keys and Display

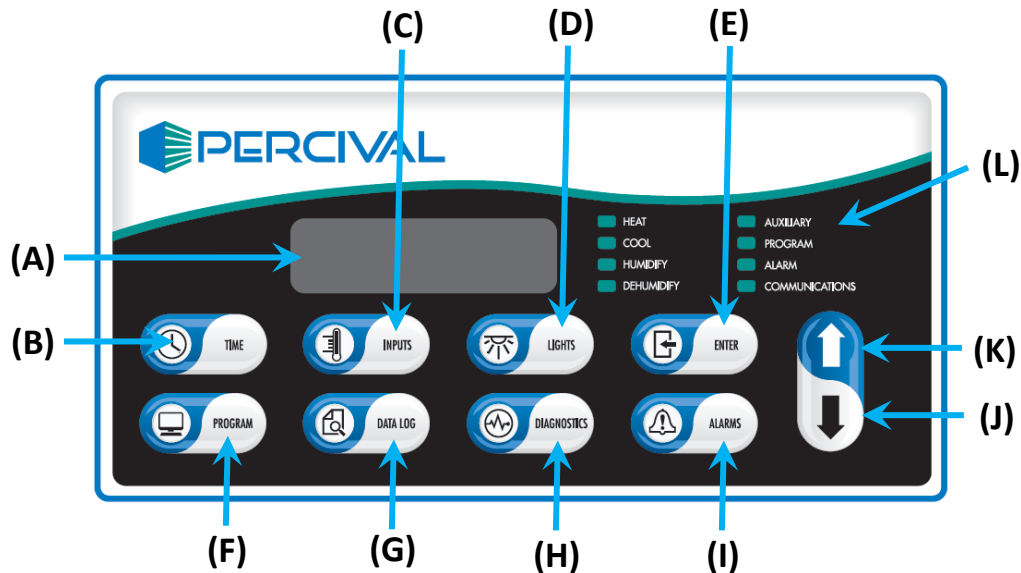


Figure 1 – IntellusUltra Display and Key Reference

(A) Main Display, (B) Time Key, (C) Inputs Key, (D) Lights Key, (E) Enter Key, (F) Program Key, (G) Data Log Key, (H) Diagnostics Key, (I) Alarms Key, (J) Decrement Key, (K) Increment Key, (L) LED Indicators

Refer to Figure 1:

Main Display (A)

The main display shows all status and programming information.

Time Key (B)

The Time key is used to set the system time.

Inputs Key (C)

The Inputs key is used to enter the Inputs menu. The Inputs menu contains entries for the Manual settings for temperature, humidity (if applicable), and any

auxiliary/expansion channels (if applicable). It is also used to enable or disable the outputs for the humidity input (e.g. humidify/dehumidify) and the outputs for any additional auxiliary/expansion channels.

Lights Key (D)

This key is only active when one or more of the following systems is provided on a chamber:

- On/off lighting
- On/off event output
- Open-loop dimmable lighting

The Lights key is used to enter the Lights menu. The Lights menu contains entries for individual light and event settings, management of light lifetime information, and setting of the light lifetime alarm.

Enter Key (E)

This key is used to initiate the editing of values and to accept any changes made to them.

Program Key (F)

This key is used to enter the Program menu. The Program menu contains selections used to enter/edit programs, run programs or run manual settings. Please refer to the section titled “Programming” for more information.

Data Log Key (G)

This key is only active when an IntellusUltraConnect (C9) control system option is installed. The Data Log key is used to enter the Data Log menu. This menu is used to export data from the controller to a USB flash drive. Refer to the section titled “Data Log” for more information.

Diagnostics Key (H)

This key is used to enter the Diagnostics menu which allows the user to view diagnostic information for the chamber. Refer to the section titled “Diagnostics” for more information.

Alarms Key (I)

This key is used to enter the Alarms menu. The Alarms menu contains entries for setting high and low alarm settings for each of the process loops enabled on the IntellusUltra or IntellusUltraConnect control system. Refer to the section titled “Alarms Menu” for more information.

Decrement (J) / Increment (K) Keys

These keys are used to scroll through available menu options and to decrease or increase values.

Status LEDs (L)

- The Heat LED illuminates when the controller calls for chamber heating.
- The Cool LED illuminates when the controller calls for chamber cooling.
- The Humidify LED illuminates when the controller calls for the level of humidity to increase in the chamber.
- The Dehumidify LED illuminates when the controller calls for the level of humidity to decrease in the chamber.
- The Auxiliary LED illuminates when the controller calls for the level of the auxiliary channel to increase in the chamber.
- The Program LED illuminates when the controller is running a program. The LED is off when the controller is running manual settings. The LED flashes when entering/editing a program. Refer to the sections titled “Running Manual Settings” and “Programming” for more information.
- The Alarms LED illuminates when there is an active alarm on the control system. Refer to the section titled “Alarms” for more information.
- The Communications LED illuminates when the controller is communicating over the Ethernet.

Note: Only the appropriate LEDs for the options ordered will function.

IntellusUltra Basic Operation

When power is applied to the IntellusUltra controller, the controller will boot up. This process takes approximately 15-20 seconds. During startup, the controller will display the firmware version it's currently running, then will display a screen which shows the following chamber conditions:

- Current system time
- Current temperature, humidity and auxiliary process values inside the chamber.
- Current status of the first 8 light and event outputs

This display will be referred to as the “main display” throughout this manual. After one minute with no key activation, the controller will revert to the main display.

Setting Time

To set the system time, use the following steps:

- 1) Press the TIME key.
- 2) Press the ENTER key.
- 3) Use the ▼ and ▲ keys as necessary to set the current time and then press ENTER.
- 4) Press the TIME key to return to the main menu.

Main Display/Status Menu

3:30PM	24.0C	75%RH
LT:110		800PPM

Figure 2 – Main Display

The main display shows the following information:

- Current time (3:30PM in Figure 2). When the program type has been set to Elapsed Non-Ramping or Elapsed Ramping (see Setting Program Step Type and Operation Mode), the time on the main display will read “000:00” when manual settings are running or will show the current step time remaining when running a program or sequence.
- Current temperature (24.0C in Figure 2). For dew chambers this is the current wall temperature.
- Current %RH (75% in Figure 2). **Note:** Only displays if a humidity option was ordered.
- Current light settings (110 in Figure 2). **Note:** Only displays if a lighting option was ordered. If a non-feedback (open loop) dimmable lighting option was ordered each output is displayed as a graphical block.
- Current Aux level (800PPM in Figure 2). **Note:** Only displays if an auxiliary option was ordered. For dew chambers this is the current water temperature.

The main display screen is only one of multiple screens in the Status Menu. The additional screens within this menu display the following information:

- Alarm information.
- Current process values in the chamber (main display). Refer to Figure 2.
- Current process values for control loops 4-7
- Current set points for all enabled process loops
- Lighting status (displays only if lighting option was ordered with chamber)
- Detailed status of individual light and event outputs
- Current temperature process value of the independent temperature limit (Limit 2). For dew chambers this is the current air temperature.
- Program status (if a program or program sequence is running)
- Program sequence status (if a program sequence is running)

To navigate through the Status menu, use the ▼ and ▲ keys as necessary starting from the main display.

Lighting

The IntellusUltra controller is capable of programming and displaying up to forty-seven separate event outputs. Event outputs are most typically purposed for controlling lights, but they can also be used for non-lighted on/off-type events such as switched power receptacles and watering systems. Not all of these outputs will be utilized in every chamber. The most common configuration on a chamber is 2 or 3 light events. The controller only displays the total number of light/event outputs utilized.

On/Off outputs are normally displayed using a '1' to represent on and a '0' to represent off (Refer to Figure 2). According to this display, light outputs #1 and #2 are on and light output #3 is off. If a non-feedback (open loop) dimmable lighting option was ordered, lights are displayed as graphical blocks. Please refer to the sections titled "Lights Menu" and "Programming" for more information on using the controller to program chamber lighting.

Inputs Menu

The Inputs menu contains the following submenus (standard input names in parentheses):

Temperature Submenu (TEMP)

- Manual temperature set point. For dew chambers this is the manual wall temperature set point.
- Number of defrosts (only appears if low temperature option was ordered).
- Defrost Duration (only appears if low temperature option was ordered).
- Defrost X Start (only appears if low temperature option was ordered).

Humidity Submenu (%RH)

The humidity submenu is only accessible if a humidity option was ordered.

- Manual humidity (%RH) set point.
- Enable Channel A (only appears when humidification system is ordered)
- Enable Channel B (only appears when dehumidification system is ordered)

Auxiliary Submenu (AUX)

The auxiliary submenu is only accessible on dew chambers (as standard), or if an auxiliary option was ordered. The default process loop name is AUX, however, this submenu may be labeled to represent the type of process it's configured to

control. Common input names are CO₂ (for CO₂ systems) and LS1 (for closed-loop dimmable lighting control with light sensor). For dew chambers, the auxiliary channel is labeled H₂O as the process loop is used to control the water pan temperature.

- Manual AUX channel set point.
- Enable Channel A (may not appear depending on the auxiliary system ordered). For dew chambers this channel must always be enabled in order for dew to form.
- Enable Channel B (may not appear depending on the auxiliary system ordered).

Expansion Slots 4-7 Submenus (RMC4 - RMC7)

These submenus are only accessible if additional process loops beyond the three primary process loops are specified or required on the chamber control system. The default process loop names are RMC4, RMC5, RMC6 and RMC7. The inputs may be renamed to represent the type of process they are configured to control, similar to the above-described AUX channel. Each process loop will have its own submenu with the following settings:

- Manual (RMC#) set point.
- Enable Channel A (only appears when humidification system is ordered).
- Enable Channel B (only appears when dehumidification system is ordered).

Menu Entry

To enter the Inputs menu, press the **INPUTS** key.

Menu Navigation

To navigate through the menu, use the ▼ and ▲ keys as necessary. To enter a submenu, press the **ENTER** key.

Modifying Settings

To change any setting, press the **ENTER** key, use the ▼ and ▲ keys as necessary to change the setting and then press the **ENTER** key again to accept the change.

Exiting Menu

To exit the Inputs menu, press the **INPUTS** key until you reach the main display.

Manual Temperature Set Point (Manual Setpoint)

This set point is used when running manual settings. Refer to the section titled “Running Manual Settings” for more information.

Defrost Cycle

Scheduled defrost cycles only occur when the chamber temperature process value is below the temperature at which the evaporator coil will freeze over time. This temperature threshold is pre-programmed into the IntellusUltra control system by Percival Scientific’s technicians as part of the manufacturing process for chambers with low temperature options. If the chamber temperature is above this threshold, no scheduled defrost periods will occur.

During each active defrost period, the following sequence of events occurs inside a chamber:

- 1) Evaporator fans are de-energized
- 2) All light and event outputs are de-energized
- 3) Outputs for process control loops 1 (TEMP) and 2 (%RH, if enabled) are disabled
- 4) Process control loops 3-7 (if enabled) operate normally
- 5) The evaporator coil is de-iced via either or both refrigerant hot gas and electric heaters
- 6) At the end of the sequence, all regular chamber process control functions and programmed output states are resumed, with the exception of the evaporator fans
- 7) After a short duration, which allows the evaporator coil to pre-cool, the evaporator fans are re-energized

Number Of Defrosts (only appears if it is determined that the chamber may need defrost periods)

This setting determines the number of defrost periods that will occur over a twenty-four hour period. A setting of 0 effectively disables the defrost capabilities on a chamber as no periods will be scheduled. A maximum number of six periods can be programmed. When constantly running at low temperatures, Percival Scientific recommends a setting of two defrost periods, set approximately twelve hours apart. The necessity for programming defrost periods can be gauged by observing the inability of the chamber to hold the set point at low temperatures.

User Tip: Defrost periods can be configured to occur immediately before and after day (lights on) periods to maximize their effectiveness, negate their effect on the lights (see Defrost Cycle section, above) and minimize the number of disruptions to the temperature control.

Defrost Duration (only appears if it is determined that the chamber may need defrost periods)

This setting determines the length that each defrost period will last. The duration can be set between one and 999 minutes. Percival Scientific recommends seven minutes for each defrost period. Refer to the section titled “Defrost Programming” for more information.

Defrost X Start (only appears if it is determined that the chamber may need defrost periods)

A prompt will appear to enter the start time for each defrost period. The number of periods is selected under the ‘Number Of Defrosts’ prompt. Refer to the section titled “Defrost Programming” for more information.

Manual Humidity Set Point (Manual Setpoint - only appears when a humidification/dehumidification system is ordered)

This set point is used when running manual settings. Refer to the section titled “Running Manual Settings” for more information.

Enable Humidify Setting (Enable Channel A - only appears when humidification system is ordered)

This setting is used to turn the chamber humidification system on or off. A setting of ‘On’ will activate the humidification system as necessary. When an extreme low level of humidity is required, it is recommended that the ‘Enable Humidify’ setting be set to ‘Off’.

Enable Dehumidify Setting (Enable Channel B - only appears when dehumidification system is ordered)

This setting is used to turn the chamber dehumidification system on or off. A setting of ‘On’ will activate the dehumidification system as necessary. When an extreme high level of humidity is required, it is recommended that the ‘Enable Dehumidify’ setting be set to ‘Off’.

Manual Auxiliary Set Point (Manual Setpoint - only appears when auxiliary system is ordered)

This set point is used when running manual settings. Refer to the section titled “Running Manual Settings” for more information.

Enable Aux Output 1 Setting (Enable Channel A - may not appear depending upon the auxiliary system ordered)

This setting is used to turn the auxiliary output side A of the chamber on or off. A setting of ‘On’ will activate the output as necessary.

Note: When the auxiliary channel is used for closed loop dimmable lighting or a dew chamber was ordered this setting should always be set to ‘On’.

Enable Aux Output 2 Setting (Enable Channel B - may not appear depending upon the auxiliary system ordered)

This setting is used to turn the auxiliary output side B of the chamber on or off. A setting of ‘On’ will activate the output as necessary.

Manual Expansion Slot 4-7 Set Points (Manual Setpoint - only appears when a system requiring an expansion slot is installed)

This set point is used when running manual settings. Refer to the section titled “Running Manual Settings” for more information.

Enable Expansion Slot 4-7 Output Setting (Enable Channel A - may not appear depending upon the expansion slot system installed)

This setting is used to turn the auxiliary output side A of the chamber on or off. A setting of ‘On’ will activate the output as necessary.

Note: When the auxiliary channel is used for closed loop dimmable lighting or a dew chamber was ordered this setting should always be set to ‘On’.

Enable Expansion Slot 4-7 Output Setting (Enable Channel B - may not appear depending upon the expansion slot system installed)

This setting is used to turn the auxiliary output side B of the chamber on or off. A setting of ‘On’ will activate the output as necessary.

Lights Menu

The Lights menu is only accessible when light or event outputs are ordered.

The Lights menu contains the following settings:

- Settings for Light/Event outputs 1-47
- Light lifetime display for lighting outputs 1-47
- Light lifetime reset for lighting outputs 1-47
- Light lifetime alarm setting

Changing light settings in this menu when running a program will override the programmed light settings for the current executing step.

Note: Not all available outputs will be utilized in every chamber. The most common configuration on a chamber is 2 or 3 light events. The controller only displays the total number of light/event outputs utilized.

Menu Entry

To enter the Lights Menu, press the **LIGHTS** key.

Menu Navigation

To navigate through the menu, use the ▼ and ▲ keys as necessary.

Modifying Settings

To change any setting, press the **ENTER** key, use the ▼ and ▲ keys as necessary to change the setting and then press the **ENTER** key again to accept the change.

Exiting Menu

To exit the Lights Menu, press the **LIGHTS** key.

Lighting Settings

These settings are used to manually change the lighting settings. When standard lighting is provided a setting of 'On' will turn the lights connected to the output on. A setting of 'Off' will turn the lights connected to the output off. When non-feedback (open loop) dimmable lighting is provided, each output can be set for a level between 0% and 100%. Changing light settings in this menu when running

a program will override the programmed light settings for the current executing step.

Note (open loop dimmable lighting): Certain fluorescent and HID (high intensity discharge) lighting systems will turn off when the lighting level is set between 0 and a factory preset threshold value. This limit is based on the minimum output level required to provide stable lighting. Please refer to the operation manual or the supplemental information section provided with the operation manual for this threshold value. Any LED lighting systems are often an exception. A setting of 0 in most LED systems, when controlled via the IntellusUltra models will turn the LEDs off. Any setting greater than 0 will turn the LEDs on.

Light Lifetime Display

The amount of time that each light output has been energized is displayed individually for each output. This information can be used for light maintenance. For example, Percival Scientific recommends that fluorescent lights be changed at 15000 hour intervals. Each type of light source has a different, recommended maintenance schedule. Please consult your chamber's operation manual for its lighting system's maintenance requirements.

When the light lifetime for an output reaches the recommended lifetime, change the bulbs that are powered by that output. Once this has been completed, reset the light lifetime for the output.

Light Lifetime Alarm Setting

This setting determines the point at which a light lifetime alarm will occur. A light lifetime alarm will activate the alarm buzzer, display an alarm message on all IntellusUltra controller types. A light lifetime alarm will generate an alarm notification email (if configured) from IntellusUltraConnect controllers. The value is set at a default of 15000 hours. This value should be changed to the appropriate value for the type of bulbs used in your chamber. A light lifetime alarm occurs when any of the light lifetimes has exceeded the alarm setting. To silence the alarm, press any key. The lights controlled by the light output which caused the light lifetime alarm should be changed and the light lifetime reset. The alarm message will only clear by resetting the light lifetime for the light output that triggered the alarm. Refer to the section titled "Alarms" for more information.

Alarms Menu

The Alarms menu contains the settings used to define alarm thresholds for the IntellusUltra control system. Every process loop can be configured with a high and/or low alarm. The IntellusUltra control system, by default, is configured with a high and low limit alarm associated with the primary temperature control loop (Limit 1 Alarms) and a high and low limit alarm associated with an independent, redundant temperature probe (Limit 2 Alarms). All other process loops enabled on the control system do not have alarms enabled by default.

The Alarms menu contains the following settings:

Temperature Submenu (TEMP)

- Temperature limit 1 high and low alarm settings.
- Temperature limit 2 high and low alarm settings.
- Temperature deviation alarm activation setting.
- Temperature high deviation alarm setting.
- Temperature low deviation alarm setting.
- Temperature deviation alarm latching setting.
- Temperature deviation alarm buzzer setting.

Temperature Limit 1 High Alarm Setting (Limit 1 High Alarm)

This setting determines the process value at which the controller will trigger a limit 1 high alarm. When a limit alarm occurs, the chamber will shut down its control functions to protect your experiment. It is recommended that you set the Limit1 High Alarm value at least 3°C above your highest programmed temperature. When programming, be sure to note the highest temperature programmed. Use this temperature as the reference point for setting the Limit 1 High Alarm. Refer to the section titled “Alarms” for more information regarding alarms.

Temperature Limit 1 Low Alarm Setting (Limit 1 Low Alarm)

This setting determines the process value at which the controller will trigger a Limit 1 Low Alarm. When a limit alarm occurs, the chamber will shut down its control functions to protect your experiment. It is recommended that you set the Limit 1 Low Alarm value at least 3°C below your lowest programmed temperature. When programming, be sure to note the lowest temperature programmed. Use this temperature as the reference point for setting the Limit 1 Low Alarm. Refer to the section titled “Alarms” for more information regarding alarms.

Temperature Limit 2 High Alarm Setting (Limit 2 High Alarm)

This setting determines the process value at which the controller will trigger a Limit 2 High Alarm. When a limit alarm occurs, the chamber will shut down its control functions to protect your experiment. It is recommended that you set the Limit 2 High Alarm value at least 3°C above your Limit 1 High Alarm setting.

Temperature Limit 2 Low Alarm Setting (Limit 2 Low Alarm)

This setting determines the process value at which the controller will trigger a Limit 2 Low Alarm. When a limit alarm occurs, the chamber will shut down its control functions to protect your experiment. It is recommended that you set the Limit 2 Low Alarm value at least 3°C below your Limit 1 Low Alarm setting.

Temperature Deviation Alarm Activation Setting (Deviation Alarms)

This setting is used to activate or deactivate deviation alarms. Deviation alarms are informational alarms that indicate when the temperature in the chamber has deviated from set point. Refer to the section titled “Alarms” for more information regarding deviation alarms.

Temperature High Deviation Alarm Setting (High Deviation Alarm)

This setting only appears when the deviation alarm activation setting is set to ‘Yes’. This setting is the deviation value from set point at which the controller will trigger a high deviation alarm. When a deviation alarm occurs, the controller activates the alarm buzzer if the deviation alarm buzzer setting is set to ‘Yes’ and a deviation alarm message is displayed. Refer to the section titled “Alarms” for more information regarding deviation alarms.

Temperature Low Deviation Alarm Setting (Low Deviation Alarm)

This setting only appears when the deviation alarm activation setting is set to ‘Yes’. This setting is the deviation value from set point at which the controller will trigger a low deviation alarm. When a deviation alarm occurs, the controller activates the alarm buzzer if the deviation alarm buzzer setting is set to ‘Yes’ and a deviation alarm message is displayed. Refer to the section titled “Alarms” for more information regarding deviation alarms.

Temperature Deviation Alarm Latching Setting (Deviation Latching)

This setting only appears when the deviation alarm activation setting is set to ‘Yes’. This setting determines whether or not a deviation alarm is automatically

cleared if the temperature in the chamber recovers to within the deviation alarm range. Refer to the section titled “Alarms” for more information regarding deviation alarm latching.

Temperature Deviation Alarm Buzzer Setting (Deviation Buzzer)

This setting only appears when the deviation alarm activation setting is set to ‘Yes’. This setting determines whether or not the alarm buzzer activates when a deviation alarm occurs. Refer to the section titled “Alarms” for more information regarding deviation alarms.

Alarms

The IntellusUltra controller will alert users of any temperature limit alarms, temperature deviation alarms, light lifetime alarms and controller errors. An example controller error would be if a sensor were not correctly connected to the controller. Alarms cannot be set while programming.

Temperature Limit Alarms

Two sets of high and low temperature limit alarms can be configured in the Alarms menu. The first set monitors the temperature in the chamber and will trigger an alarm when the temperature goes outside the thresholds set for the Limit 1 Low and Limit 1 High Alarms. The second set independently monitors the temperature in the chamber (using a separate sensor and its own microprocessor) and will trigger an alarm when the temperature goes outside the thresholds set for the Limit 2 Low and Limit 2 Highg Alarms. The Limit 2 Alarm thresholds should be set outside of the Limit 1 Alarm thresholds.

During each active Limit Alarm, the following sequence of events occurs inside a chamber:

- 1) An audible alarm tone (buzzer) sounds
- 2) An alarm type-specific message is displayed on the Intellus display screen
- 3) The alarm LED on the control overlay flashes
- 4) An alarm message is displayed on the touch screen (if present)
- 5) An alarm message is displayed on the Monitor page of the Web Server interface (if IntellusUltraConnect is present and the Web Server has been enabled)
- 6) An alarm notification email is sent to all configured recipients via the Web Server (if IntellusUltraConnect is present, and the Web Server has been enabled)
- 7) All processes are suspended within the chamber

The alarm buzzer will continue to sound until the active alarm is acknowledged. Multiple, simultaneous alarms conditions require an individual user acknowledgement for each alarm. Limit alarms can be acknowledged in the following ways:

- 1) Press any key on the IntellusUltra overlay
- 2) Press the 'Dismiss' button on the touch screen interface (if present)
- 3) Click on the acknowledge button on Monitor page of the Web Server interface (if IntellusUltraConnect is present, and the Web Server has been enabled)

Chamber processes are suspended during an active Limit alarm in an effort to minimize the overheating or overcooling of experiments. Limit alarms are self-resetting. If conditions inside the chamber return to within the low and high alarm limit thresholds, alarm notifications will automatically be cleared, and all regular chamber functions will resume.

Alarms can also be cleared by adjusting the appropriate high or low limit alarm setting beyond the current temperature process value in the chamber.

CAUTION

Always remember to review the temperature limit alarm settings before running programs or manual settings. If manual settings are running and you intend to change the manual temperature set point change the limit alarm settings accordingly.

To adjust the temperature limit alarms use the following steps:

- 1) Press the **ALARMS** key.
- 2) Press **ENTER** at the 'TEMP' prompt.
- 3) Use the ▼ and ▲ keys as necessary to select the desired Limit alarm setting
- 4) Press the **ENTER** key to edit the selected alarm setting.
- 5) Use the ▼ and ▲ keys as necessary to change the alarm setting value.
- 6) Press **ENTER** to accept the changes.
- 7) Repeat steps 3) through 6) to set the other alarm limit thresholds
- 8) Press the **ALARMS** key to exit this menu and return to the main display.

Temperature Deviation Alarms

Temperature deviation alarms are solely informational, and do not cause chamber sub-systems to shut down, like limit alarms. Deviation alarms indicate

when the temperature in the chamber has deviated beyond a certain temperature above or below the set point – even as it changes over time.

Deviation alarm activation and high and low temperature deviation alarm settings are set in the Alarms menu in the TEMP submenu. The high and low deviation alarm settings are the values at which the process value must deviate from the set point in order for a deviation alarm to occur. The high deviation alarm is set to 5.0°C by default and the low deviation alarm is set to -5.0°C by default. **Note:** These are not the absolute temperatures at which alarms are to occur. These are the values by which the temperature process value must deviate from the set point in order to cause an alarm. For example, if the current temperature set point is 20°C and the high and low deviation alarms are set to 5.0° and -5.0°C respectively, a deviation alarm will occur if the temperature in the chamber goes above 25°C or below 15°C. The minimum value that the high deviation alarm can be set at is 2.0°C and the minimum value that the low deviation alarm can be set at is -2.0°C. It is recommended that the deviation alarm settings be left at their defaults of 5.0°C and -5.0°C.

When the deviation alarms are active, a deviation band always exists around the set point. For example, if the set point is currently 24°C and the high deviation alarm is set to 5.0°C and the low deviation alarm is set to -5.0°C, then the low side of the deviation band would be at 19.0°C and the high side would be at 29.0°C. If the controller's temperature is within the band of 19°C to 29°C and then falls outside the band then a deviation alarm will occur.

If the controller's program operation mode is set to **Ramping** (see **Setting Program Step Type and Operation Mode**), the deviation band follows the set point while ramping. The following graph illustrates how the deviation band follows the set point when the program operation mode is set to **Ramping**.

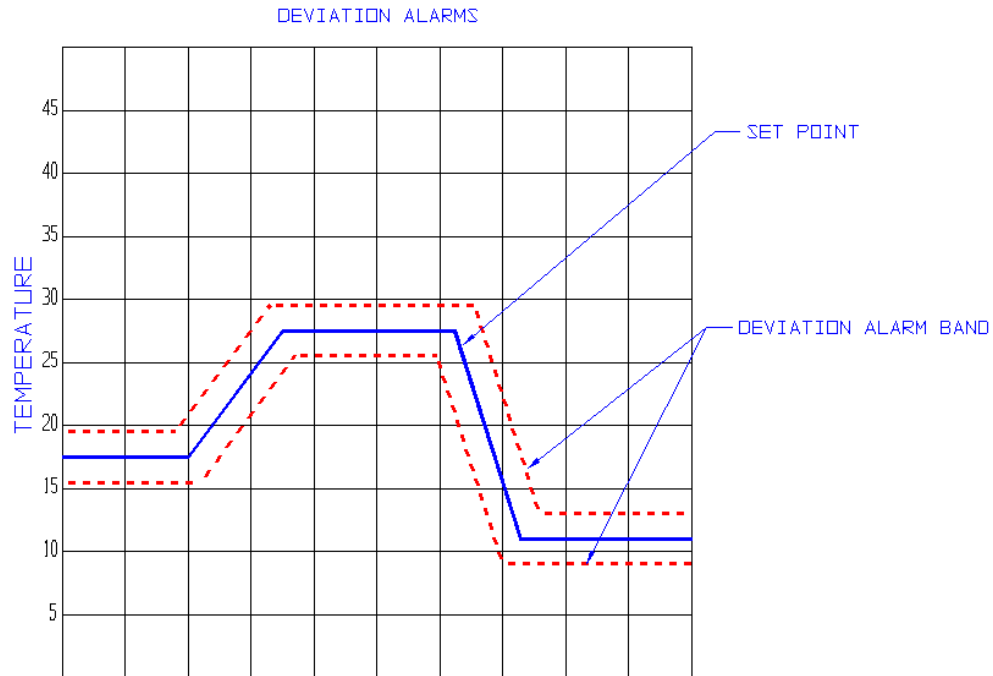


Figure 3 – Ramping Deviation Alarms Example

If the controller's program operation mode is set to **Ramping** (see **Setting Program Step Type and Operation Mode**), any time the process value is within the deviation band and then falls outside of the deviation band a deviation alarm will occur. Therefore, it is highly recommended that when you ramp between temperature set points that you allow for the time it takes for the chamber to heat or cool the chamber. For example, if you were to attempt to ramp the chamber from 2°C to 36°C in 10 minutes, the chamber would not be able to heat quickly enough and a low deviation alarm would occur. As a general rule of thumb you should figure the chamber can heat at a rate of 1°C every 2.5 minutes and cool at a rate of 1°C every minute. Therefore, in the above example you would want to allow at least 85 minutes for the chamber to ramp between 2°C and 36°C.

The following graph illustrates how the deviation band follows the set point when the program operation mode is set to **Non-Ramping**.

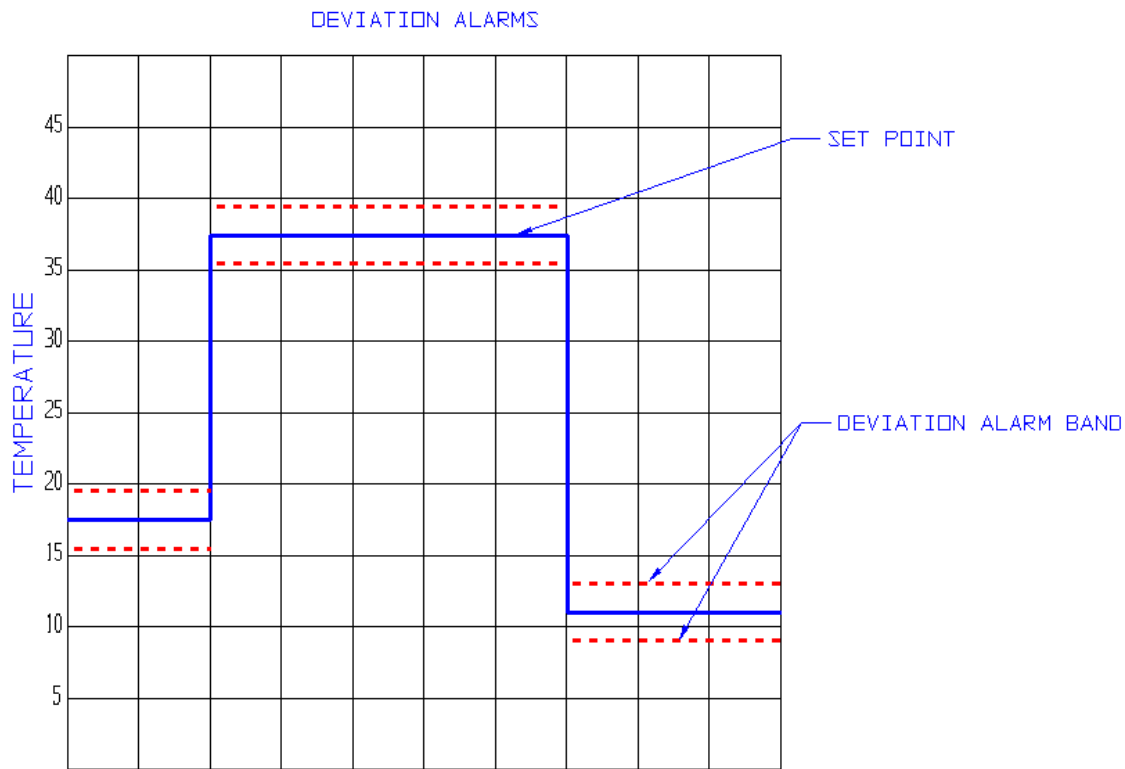


Figure 4 – Non-Ramping Deviation Alarms Example

If the controller's program operation mode is set to **Non-Ramping** (see **Setting Program Step Type and Operation Mode**), the deviation band will change immediately when the set point changes. In the above graph, when the temperature set point changes between 17.5°C and 37.5°C, the deviation band changes immediately to function around the set point of 37.5°C. A deviation alarm will not occur in this mode unless one of the following scenarios happens:

- 1) The process value in the chamber enters the new deviation band (around 37.5°C in figure 4 above) and then falls out. This prevents unwanted deviation alarms between set point changes.
- 2) The control system is unable to achieve the set point within the deviation silence time period (see **Deviation Silence Timer** section below)

Note: The description above regarding deviation alarms while operating a chamber in Non-Ramping program mode also apply to Manual mode. A manual set point change is analogous to a non-ramping program step change.

Deviation Silence Timer

When running manual settings, a diurnal program or a non-ramping program, a timer will activate whenever the set point changes. If the time set on the timer counts down to zero before the temperature process value has entered the new deviation band, a deviation alarm will occur. The purpose of the timer is to inform the user when the chamber is unable to reach the new set point in an acceptable period of time. The timer is factory set to a value of 180 minutes by default. The chamber should be able to reach any temperature change (within its specified temperature performance range) in this period of time. If the chamber has not reached the new temperature set point in three hours, a malfunction in the chamber may have occurred. The ability to change the default from 180 minutes is hidden from the user. If you desire to change the default, please contact our offices for advice on how to do so.

The deviation silence timer is not active while a ramping program is running, except for when the program is first run. After the first programmed temperature set point is achieved, any time the temperature moves outside the deviation band an alarm will occur.

Deviation Alarm Latching

When the deviation alarm latching parameter is set to 'Yes' and a deviation alarm occurs, the alarm buzzer and alarm message will continue to display until the alarm is physically cleared at the controller. Set the deviation alarm latching setting to 'Yes' in order to be informed of a deviation alarm, even if the temperature process value re-enters the deviation band. To clear a latched deviation alarm, go to the controller and use the arrow keys to view the current temperature process value and set point. If the process value has re-entered the deviation band the message should clear. If it has not, change the 'High Deviation Alarm' and 'Low Deviation Alarm' settings so that the process value is within the deviation band. The deviation alarm should clear. Next, change the deviation values back to their original settings.

When the deviation alarm latching parameter is set to 'No' and a deviation alarm occurs, the alarm buzzer and alarm message will self-clear if the temperature recovers to be within the deviation band.

Adjusting Deviation Alarm Settings

To adjust the deviation alarm settings use the following steps:

- 1) Press the **ALARMS** key.
- 2) Press **ENTER** at the 'TEMP' prompt.

- 3) Use the ▼ and ▲ keys as necessary to select 'Deviation Alarms' and then press **ENTER**.
- 4) Use the ▼ and ▲ keys as necessary to change the deviation alarms setting and then press **ENTER**. A setting of 'Yes' will activate deviation alarms and a setting of 'No' will deactivate deviation alarms. If you changed the deviation alarms setting to 'No' press the **ALARMS** key to exit the menu.
- 5) If the deviation alarms setting was changed to 'Yes', press the ▼ key to select 'High Deviation Alarm' and then press **ENTER**.
- 6) Use the ▼ and ▲ keys as necessary to change the high deviation alarm setting and then press **ENTER**. Remember, this setting adjusts the amount by which the temperature process value must deviate from set point in order to cause an alarm. For example, if your set point is 30°C and the high deviation alarm is set to 5.0°C, a high deviation alarm will be triggered at (and above) 35°C.
- 7) Press the ▼ key to select 'Low Deviation Alarm' and then press **ENTER**.
- 8) Use the ▼ and ▲ keys as necessary to change the low deviation alarm setting and then press **ENTER**. Remember, this setting adjusts the amount by which the temperature process value must deviate from set point in order to cause an alarm. For example, if your set point is 30°C and the low deviation alarm is set to 5.0°C, a low deviation alarm will be triggered at (and below) 25°C.
- 9) Press the ▼ key to select 'Deviation Latching' and then press **ENTER**.
- 10) Use the ▼ and ▲ keys as necessary to change the deviation alarm latching setting and then press **ENTER**.
- 11) Press the ▼ key to select 'Deviation Buzzer' and then press **ENTER**.
- 12) Use the ▼ and ▲ keys as necessary to change the deviation buzzer setting and then press **ENTER**. Changing the setting to 'Yes' will activate the buzzer when a deviation alarm occurs.
- 13) Press the **ALARMS** key to return to the main display.

When a deviation alarm occurs, the alarm buzzer will activate if the 'Deviation Buzzer' setting is set to 'Yes' and a message indicating the type of deviation alarm will be displayed. To stop the buzzer, press any key. To clear the deviation message, you will need to either wait until the temperature in the chamber recovers to within the deviation band or adjust the 'High Deviation Alarm' and 'Low Deviation Alarm' settings accordingly. If the 'Deviation Latching' setting is set to 'Yes' you will need to press any key to clear the message when the current temperature is within the deviation band.

Keep in mind that there are instances where an unexpected deviation alarm may occur. The following are cases where an unexpected deviation alarm may occur:

- A ramping program is running and the program attempts to ramp the temperatures over a wide range too quickly.

- The set point is changed from a low value to a high value and the chamber temperature overshoots or undershoots the new set point. For example, the set point is changed from 4°C to 35°C. If you have the high deviation alarm setting set at 2°C an alarm may occur because the chamber may overshoot 37°C.
- The door is opened.
- During a defrost period on chambers ordered with a low temperature option.

Light Lifetime Alarm

The light lifetime alarm informs the user when lamps have been in use beyond their recommended lifetime. Each light output configured in the controller will accumulate the number of hours it has been programmed on. When any of the configured light outputs has been on for longer than the light lifetime alarm setting, a light lifetime alarm will occur. When a light lifetime alarm occurs, the alarm buzzer will activate and a message indicating the alarm will be displayed. To silence the alarm, press any key. The lights controlled by the light output which caused the light lifetime alarm should be changed and the light lifetime reset. The alarm message will only clear by resetting the light lifetime for the light output that triggered the alarm.

To adjust the light lifetime alarm setting use the following steps:

- 1) Press the **LIGHTS** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Light Life Alarm' and then press **ENTER**.
- 3) Use the ▼ and ▲ keys as necessary to change the light lifetime alarm setting and then press **ENTER**.
- 4) Press the **LIGHTS** key to return to the main display.

In the event of an alarm, to investigate which light output(s) caused the alarm use the following steps:

- 1) Press the **LIGHTS** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Light 1 Life'. Review this value. If it's greater than the light lifetime alarm setting then the accumulated lifetime for this light output should be reset.
- 3) Press the ▼ key repeatedly to review each additional light output configured on the chamber. If the light lifetime for any additional light output exceeds the light lifetime alarm setting then reset the accumulated lifetime for that output.
- 4) Press the **LIGHTS** key to return to the main display.

To reset the accumulated light lifetime of a light output use the following steps:

- 1) Press the **LIGHTS** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Light x Reset Time' where x is the number of the light output you want to reset and then press **ENTER**.
- 3) Use the ▼ and ▲ keys as necessary to select 'Yes' and then press **ENTER**.
- 4) Either user the ▼ and ▲ keys as necessary to select another light output to reset or press the **LIGHTS** key to return to the main display.

Controller Errors

When a controller error alarm occurs, a message indicating the type of alarm will be displayed and the alarm buzzer will activate. To stop the buzzer, press any key. To clear the alarm, you will need to correct the cause of the alarm.

Using Auxiliary Channel For Closed-Loop Dimmable Lighting (optional)

If the option was ordered to control the level of lighting via feedback from a light sensor then the auxiliary channel has been configured for this purpose. The current level of lighting read by the light sensor is displayed in the lower right hand corner of the display.

When running manual settings, the Inputs – Auxiliary submenu (typically labeled LS1) is used to set the level of lighting required. Refer to the 'Inputs Menu – Auxiliary submenu' section of this manual for information on using this menu to control lighting when running manual settings. Lighting levels can be programmed using the programming features of the controller. For more information on programming the lighting levels please refer to the "Programming" section.

Dimmable ballasts have a minimum level at which they can produce a stable lamp output. The controller has been configured to turn off the lights at a set point below this level. Please refer to the operation manual or supplemental information that has been provided with the operation manual for information on the threshold value at which the dimmable lamps will turn off.

⚠ CAUTION

When this option is provided, the 'Enable Channel A' option in the Inputs – Auxiliary submenu should always be set to 'On'.

Using Auxiliary Channel For CO₂ (optional)

If the option was ordered to control the level of CO₂ via feedback from a CO₂ sensor then the auxiliary channel has been configured for this purpose. The current level of CO₂ read by the sensor is displayed in the lower right hand corner of the display.

When running manual settings, the Inputs – Auxiliary submenu (typically labeled CO₂) is used to set the level of CO₂ required. Refer to the 'Inputs Menu – Auxiliary submenu' section of this manual for information on using this menu to control CO₂ when running manual settings. CO₂ levels can be programmed using the programming features of the controller. For more information on programming the CO₂ levels please refer to the "Programming" section.

⚠ CAUTION

When this option is provided, the 'Enable Channel A' option in the Inputs – Auxiliary submenu should be set to 'On' when additive CO₂ is required. If an optional CO₂ removal system is provided, the 'Enable Channel B' option in the Inputs – Auxiliary submenu should be set to 'On' when CO₂ removal is required.

Running Manual Settings

Constant set points for temperature, humidity (if provided), auxiliary (if provided), expansion channels (if provided) and lighting can be run as necessary via manual settings. Use the following procedure to configure the manual settings:

- 1) Press the **INPUTS** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'TEMP' and then press **ENTER**.
- 3) You will be prompted to enter the 'Manual Setpoint'. Press **ENTER**. Use the ▼ and ▲ keys as necessary to change the manual temperature set point and then press **ENTER**.
- 4) Press the ▲ key to return to 'Input Select' menu. The display should read 'Input Select', with a flashing input name (such as TEMP)
- 5) Use the ▼ and ▲ keys as necessary to select the desired Input (control loop) and press **ENTER**.
- 6) You will be prompted to enter the 'Manual Setpoint'. Press **ENTER**. Use the ▼ and ▲ keys as necessary to change the manual set point and then press **ENTER**.
- 7) To set the manual set point of any additional Inputs, repeat steps 4) through 6).
- 8) Once all settings have been made, press the **INPUTS** key to exit to the main display.

If lighting was ordered:

- 1) Press the **LIGHTS** key. You will be prompted to enter the setting for the 'Light 1 Output'.
- 2) Press **ENTER**. Use the ▼ and ▲ keys as necessary to change the setting for the light 1 output and then press **ENTER**.
- 3) Press the ▼ key. If the Light 2 Output has been configured you will be prompted to enter the setting for the 'Light 2 Output'.
- 4) Repeat steps 2) and 3) to change each additional configured light output until you are prompted with the 'Light 1 Life' value.
- 5) Press the **LIGHTS** key to exit to the main display.

When the transition is made from any multi-step Program Mode to Manual Mode, the manual settings are automatically overwritten to the current program step's set points. This is because certain controller functions are inaccessible when a multi-step program is running, and it allows for minimal disruption to a multi-step program scenario if adjustments to any controller settings requiring Manual Mode operation are necessary. In order to implement new manual settings, terminate any running multi-step program and set the controller to operate in Manual Mode first, otherwise the new settings will be overwritten as described above. To set the IntellusUltra to Manual mode, press the

PROGRAM key to enter the Program Menu. Use the ▼ and ▲ keys as necessary to select 'Run Manual' and then press **ENTER**.

Note: When the program step type and operation mode has been set to Elapsed Non-Ramping or Elapsed Ramping (see **Setting Program Step Type and Operation Mode**), the time on the main display will read "000:00" to indicate that manual settings are running.

Programming

The IntellusUltra controller allows for the entry of up to 50 different programs spread over a total of 500 steps when configured to run with a step type of '24 Hour' (see **Setting Program Step Type and Operation Mode**). The controller allows for the entry of up to 20 different programs spread over a total of 60 steps when configured to run with a step type of 'Elapsed' (see **Setting Program Step Type and Operation Mode**). Each program can be given a unique eight-character name. The "Program Sequence" feature can be used to sequence multiple programs. This feature is used to link multiple programs over multiple days.

It is important to remember to set the temperature limit alarms accordingly before running a program. Set the limit 1 high alarm above the highest temperature set in the program or sequence of programs. Set the limit 1 low alarm below the lowest temperature set in the program or sequence of programs. Also remember to set the limit 2 values accordingly.

Setting Program Step Type and Operation Mode

Programs can operate in either non-ramping or ramping mode. The default mode is non-ramping. When programs are run in non-ramping mode, the controller will immediately change to the new set points upon changing steps. For example, if steps are programmed at 6:00AM for 10°C and at 12:00PM for 24°C, the set point will be 10°C between 6:00AM and 11:59AM, then change to 24°C at 12:00 PM.

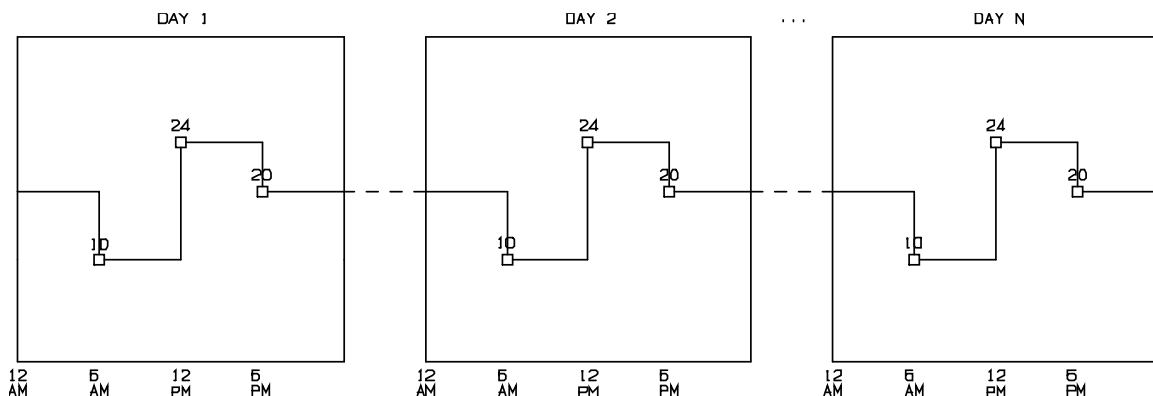


Figure 5 – Sample non-ramping program

When programs are run in Ramping Mode, the controller will ramp the set point as necessary between the current step's set point and the next step's set point. For example, if steps are programmed at 6:00AM for 10°C and at 12:00PM for 24°C, the set point will ramp between 10°C and 24°C over six hours. At 9:00AM (half way through the ramp), the temperature set point will be 17°C (half way between 10°C and 24°C). Figure 6 illustrates this example. Between 6:00AM and 12:00PM the set point (and subsequently process value) will increase approximately .04°C per minute.

Note: Please be aware of the rate of change of each ramping step if Deviation Alarms are enabled. Refer to the section entitled **Deviation Alarms** above.

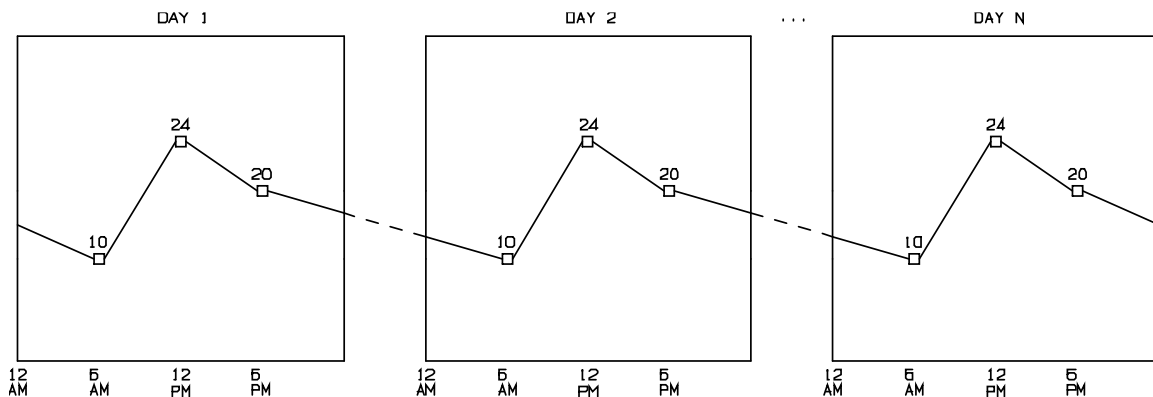


Figure 6 – Sample ramping program

Non-ramping steps can be simulated during a ramping program. Using the previous example, to hold the temperature at 10°C between 6:00AM and 12:00PM, add a step at 11:59AM with a temperature set point of 10°C. The controller will maintain the temperature at 10°C between 6:00AM and 11:59AM and at 12:00AM will immediately change the set point to 24°C. Please be aware this will cause a Deviation Alarm to occur (if enabled).

In addition to step-type and ramping-type profiles, the controller is capable of running programs using either 24 Hour or Elapsed timing methods. The default timing method used is 24 Hour. When using the 24 Hour timing, programs are created and run within a 24 hour period. The time parameter of each step can range from 12:00AM to 11:59PM. When a program is run using 24 Hour timing, the program will either repeat itself from the beginning or move to the next program, if a sequence of programs is running.

When using the Elapsed timing, programs can be created to run for periods shorter, or longer, than 24 hours. The time parameter of each step can range from 1 minute to 999 hours and 59 minutes. When a program is run using the Elapsed step timing, the

program will count down the time in each of the programmed steps until the time on the last step has count down to zero. At this point the program will either repeat itself from the beginning, or move to the next program if a sequence of programs is running.

Elapsed timing is appropriate for non-circadian experiments. For example, a 17 hour 'short day' program cycle can be accomplished with Elapsed timing with a 10 hour step with light on (day) and a 7 hour lights off step (night). At the end of each 17 hour period, this Elapsed time program will repeat itself.

Elapsed-type multi-step programs follow the same ramping/non-ramping step conventions as 24 Hour-type multi-step programs described above. Set points are held static until the next step in non-ramping programs, and set points are linearly increased/decreased (ramped) between set points in ramping programs.

Note: When using the Elapsed step type it is recommended that you run manual settings before running a program or sequence. If you are currently running a program (including diurnal) and want to switch to running another program, run manual settings first.

Note: If you have created a sequence of programs, this sequence will be lost when changing step types.

The default multi-step program type is 24 Hour, Non-Ramping. Set the multi-step program type using the following steps:

- 1) Press and hold both the **ENTER** and **▲** keys simultaneously for approximately four seconds. The controller will prompt the user to enter the security level password. The default password is '1111'. If this password does not work, the security settings may have been changed. If this is the case, contact the person responsible for securing the controller and have them enter the password.
- 2) If the first character of the password is not flashing, press the **ENTER** key.
- 3) Use the **▼** and **▲** keys as necessary to change characters. Press the **PROGRAM** key to advance to the next character. Repeatedly press the **PROGRAM** key to scroll through and review the password. Pressing the **PROGRAM** key at the last character will cause the character selection to wrap around.
- 4) Press the **ENTER** key when the security level password has been successfully entered.

CAUTION

Once the User Setup Menu is accessed, the IntellusUltra's security settings can be changed! While navigating through this menu the user will be prompted to change the LVL1 – LVL3 and SLVL passwords. Do not change any of these passwords unless you intend to activate security or change passcodes on the IntellusUltra controller.

- 5) Use the ▼ and ▲ keys as necessary until 'Program Type' appears in the upper display and then press **ENTER**.
- 6) Use the ▼ and ▲ keys as necessary to select '24 Hour Ramping', '24 Hour Non-Ramping', 'Elapsed Ramping' or 'Elapsed Non-Ramping' and press **ENTER**.
- 7) Press and hold both the **ENTER** and ▲ keys simultaneously for approximately four seconds to return to the main status menu. The controller is now set to run programs in the step type and operation mode chosen.

Diurnal Programming

The Diurnal Program allows users to quickly set up a simple 2-step day/night program. When editing a Diurnal Program, the controller prompts the user to enter the relevant day and night set points for the options ordered and day period start and end times. The night period is automatically assumed to be the remainder of the 24 hour period minus the length of the day period. During the day period, all light outputs will be on. During the night period, all light outputs will be off.

A Diurnal Program can be changed in the Enter/Edit Diurnal submenu under the main Programming menu. Locate this submenu as follows:

- 1) Press the **PROGRAM** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Enter/Edit Diurnal' and then press **ENTER**.
- 3) Use the ▼ and ▲ keys as necessary to review settings.
- 4) If any setting needs to be changed, press the **ENTER** key, use the ▼ and ▲ keys as necessary to change the setting and then press **ENTER** to accept.
- 5) Once you are finished, keep pressing the ▼ key until you return to the Program Menu. To exit the Program Menu, press the **PROGRAM** key.

To program or edit a Diurnal Program, use the following steps:

- 1) Press the **PROGRAM** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Enter/Edit Diurnal' and then press **ENTER**. **Note:** The Program LED flashes when programming.
- 3) Enter the day set point for temperature. To change the day set point for temperature, press the **ENTER** key, use the ▼ and ▲ keys as necessary to set the day set point and then press the **ENTER** key again to accept the setting.
- 4) Press the ▼ key to advance to the next setting.
- 5) If any other inputs (process loops) are present, enter their desired day set points. To change the input's day set point, press the **ENTER** key, use the ▼ and ▲ keys as necessary to set the desired value, then press the **ENTER** key to accept the setting. If no options were ordered, or all desired day settings have been made, proceed to step 8).
- 6) Press the ▼ key to advance to the next setting.
- 7) Repeat steps 5) and 6) to adjust day set points for all desired Inputs.
- 8) Set the day period start time. During the day period all light outputs will be on. During the night period all light outputs will be off. To change the day period start time, press the **ENTER** key, use the ▼ and ▲ keys as necessary to set the day period start time and then press the **ENTER** key again to accept the setting.
- 9) Press the ▼ key to advance to the next setting.
- 10) Set the day period end time (this could also be considered the night start time). To change the day period end time, press the **ENTER** key, use the ▼ and ▲ keys as necessary to set the day period end time and then press the **ENTER** key again to accept the setting.
- 11) Press the ▼ key to advance to the next setting.
- 12) If any outputs have been configured to operate as non-light, event-style outputs, select whether or not the event(s) should be powered during the day portion of the program. Non-lighting events may be used for such things as watering systems or powering a convenience outlet. If this prompt appears, press the **ENTER** key and use the ▼ and ▲ keys as necessary to set the Day Events Powered setting, then press the **ENTER** key again to accept the setting. If this prompt does not appear, proceed to step 14)
- 13) Press the ▼ key to advance to the next setting.
- 14) Enter the night set point for temperature. To change the night set point for temperature, press the **ENTER** key, use the ▼ and ▲ keys as necessary to set the night set point, then press the **ENTER** key again to accept the setting.
- 15) Press the ▼ key to advance to the next setting.
- 16) If any other inputs (process loops) are present, enter their desired night set points. To change the input's night set point, press the **ENTER** key, use the ▼ and ▲ keys as necessary to set the desired value, then press the **ENTER** key to accept the setting. If no options were ordered, or all desired night settings have been made, proceed to step 19).

- 17) Press the ▼ key to advance to the next setting.
- 18) Repeat steps 5) and 6) to adjust day set points for all desired Inputs.
- 19) Press the ▼ key to return to the Program Menu. To exit the Program Menu, press the **PROGRAM** key.

To run a Diurnal Program, use the following steps:

- 1) Press the **PROGRAM** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Run Diurnal' and then press **ENTER**. The diurnal program will now run.

In addition to the program LED being illuminated, the main status screen will display "Day" or "Night" in place of the system time to indicate that the Diurnal Program is running.

IMPORTANT!

The diurnal program always runs in 24 hour non-ramping mode regardless of the configured program step type and operation mode.

Daily Light Integral (DLI) Programming

The daily light integral programming method is an optional programming method that requires a light sensor, and must be specifically ordered. If the chamber is configured with the DLI option, then this programming method will appear under the programming menu.

The term “daily light integral” refers to the number of light particles, or photons, received during one day in a particular location and area. Photons that have a wavelength between 400 and 700 nanometers (nm) provide the energy for photosynthesis, which is the process of converting water and carbon dioxide into sugars and oxygen. These sugars are then used for plant growth. The DLI specifically refers to the amount of light received in 1 sq.m. of area, which equals 10.8 sq.ft. DLI refers to the amount of photosynthetic light received in 1 sq.m. of area each day, and has units of mol/m²/day. *

Conceptually, DLI is similar to the rain gauge in your backyard. A rain gauge is not used to measure the amount of rain per second or per minute but to measure the total amount of rain received in that particular location. If you empty your rain gauge every night, you can measure the total amount of rain received during a 24-hour period. Similarly, a light meter can be used to measure how many photons of light accumulate per square meter every day. * Percival Scientific’s daily light integral option includes a light sensor on the auxiliary channel to measure the light intensity within the chamber.

The daily light integral program consists of setting the day and night temperature and any additional control loops (if provided), a day start time, a day end time and the photosynthetic photon flux (PPF) and DLI values for the plant being experimented upon. Plant growth tables are provided at the end of this manual. These tables may be referenced to determine the temperatures and PPF and DLI values required to grow various plant varieties to different stages of maturity.

When a DLI program is run, the lights will turn on at the ‘Day Start Time’ to the desired intensity defined by the ‘Day Lights’ setting, and the daily light integral (DLI) will begin to accrue. The lighting level will be set to a constant level equal to the programmed PPF value. Once the DLI has accumulated to the programmed DLI value, or the day period end time is reached, the lights will automatically turn off for the remainder of the 24-hour day. This process repeats daily, until the program is suspended.

Note: If controller power is cycled during a DLI program, the accrued DLI value is reset to zero.

To program or edit a DLI program, use the following steps:

- 1) Press the **PROGRAM** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Enter/Edit DLI' and then press **ENTER**.
- 3) Use the ▼ and ▲ keys as necessary to review settings.
- 4) If any setting needs to be changed, press the **ENTER** key, use the ▼ and ▲ keys as necessary to change the setting and then press **ENTER** to accept.
- 5) Once you are finished, keep pressing the ▼ key until you return to the Program Menu. To exit the Program Menu, press the **PROGRAM** key.

A DLI Program can be changed in the Enter/Edit DLI submenu under the main Programming menu. Locate this submenu as follows:

- 1) Press the **PROGRAM** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Enter/Edit DLI', then press **ENTER**. **Note:** The Program LED flashes when programming.
- 3) Enter the day set point for temperature. To change the day set point for temperature, press the **ENTER** key, use the ▼ and ▲ keys as necessary to set the day set point and then press the **ENTER** key to accept the setting.
- 4) Press the ▼ key to advance to the next setting.
- 5) If any other inputs (process loops) are present, enter their desired day set points. To change the input's day set point, press the **ENTER** key, use the ▼ and ▲ keys as necessary to set the desired value, then press the **ENTER** key to accept the setting. If no options were ordered, or all desired day settings have been made, proceed to step 8).
- 6) Press the ▼ key to advance to the next setting.
- 7) Repeat steps 5) and 6) to adjust day set points for all desired Inputs.
- 8) Enter the daily light integral value. This value may be obtained by referencing the plant growth tables at the end of this manual. Find the plant variety that is the focus of the experiment and enter either the propagation, vegetative, flower initiation/development or fruit/seed development DLI value. This value is assumed to be entered as mol/m²/day. To enter the DLI value, press the **ENTER** key, use the ▼ and ▲ keys as necessary to set the DLI value and then press the **ENTER** key to accept the setting.
- 9) Press the ▼ key to advance to the next setting.
- 10) Enter the day lights value. This value may be obtained by referencing the plant growth tables at the end of this manual. Find the plant that is the focus of the experiment and enter either the propagation, vegetative, flower initiation/development or fruit/seed development PPF value. To enter the PPF value, press the **ENTER** key, use the ▼ and ▲ keys as necessary to set the PPF value and then press the **ENTER** key again to accept the setting.

Note: The required light intensity setting defined by the plant growth table may be higher than the chamber model can achieve. In this case, set the day lights value as high as the menu will allow. The DLI program will operate in 'Day' mode for a longer duration than the theoretical day length defined in the plant growth tables in order to accrue the required light integral.

- 11) Press the ▼ key to advance to the next setting.
- 12) Enter the day period start time. During the day period, all lights will be on. During the night period all lights will be off. To change the day period start time, press the **ENTER** key, use the ▼ and ▲ keys as necessary to set the day period start time and then press the **ENTER** key again to accept the setting.
- 13) Press the ▼ key to advance to the next setting.
- 14) Enter the day period end time. To change the day period end time, press the **ENTER** key, use the ▼ and ▲ keys as necessary to set the day period end time, then press the **ENTER** key again to accept the setting. Assuming the chamber lighting system can achieve the required intensities defined by the plant growth table, the day period end time should typically be set at a value greater than the day start time plus the photoperiod length as determined by the plant growth tables. For example, the photoperiod length for propagation of Corn is 14 hours. If the day period start time is set at 6:00AM, the day period end time should be set to sometime after 8:00PM. To be safe, always allow for extra time as the accumulated daily light integral may not accumulate to the programmed DLI value over the length of time between the day start period and day end period. This value can also be used to force the lights off regardless of the accumulated DLI value.

Note: If a chamber's lighting system is significantly less intense than the intensity requirement defined in the plant growth table, the daily light integral will take longer to accrue than the recommended photoperiod. In certain cases, the daily integral may not be possible to achieve during a 24 hour period. Please note that certain plant varieties require a period of darkness to grow properly, so some dark cycle may be necessary, even if the daily light integral cannot be fully achieved.

- 15) Press the ▼ key to advance to the next setting.
- 16) If any lighting output has been configured to operate as a non-lighting event style output the user will be prompted to enter whether or not the event(s) should be powered during the day portion of the program. Non-lighting events may be used for such things as watering systems or powering a convenience outlet. If this prompt appears, press the **ENTER** key and use the ▼ and ▲ keys as necessary to set the Day Events Powered setting, then press the **ENTER** key to accept the setting. If this prompt does not appear, proceed to step 18).
- 17) Press the ▼ key to advance to the next setting.

- 18) Enter the night set point for temperature. To change the night set point for temperature, press the **ENTER** key, use the ▼ and ▲ keys as necessary to set the night set point, then press the **ENTER** key to accept the setting.
- 19) Press the ▼ key to advance to the next setting.
- 20) If any other inputs (process loops) are present, enter their desired night set points. To change the input's night set point, press the **ENTER** key, use the ▼ and ▲ keys as necessary to set the desired value, then press the **ENTER** key to accept the setting. If no options were ordered, or all desired night settings have been made, proceed to step 23).
- 21) Press the ▼ key to advance to the next setting.
- 22) Repeat steps 5) and 6) to adjust day set points for all desired Inputs.
- 23) Press the ▼ key to exit the DLI programming menu and return to the Program Menu.
- 24) To exit the Program Menu, press the **PROGRAM** key.

To run a DLI program, use the following steps:

- 1) Press the **PROGRAM** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Run DLI' and then press **ENTER**.
The daily light integral program will now run.

The main display will read "Day" or "Night" to indicate that the daily light integral program is running.

IMPORTANT!

The daily light integral program always runs in 24 hour non-ramping mode, regardless of the configured program operation mode and step type.

* Douglas A. Hopper, et al "Appendix, Crop Growth Requirements," in Plant Growth Chamber Handbook, ed. R.W. Langhans and T.w. Tibbitts (North Central Regional Research Publication No. 340, Iowa Agricultural and Home Economics Experiment Station Special Report No. 99, Iowa State University of Science and Technology).

Erik Runkle. "Daily Light Integral Defined." Greenhouse Product News. November 2006. www.gpnmag.com/daily-light-integral-defined.

Creating a New Multi-Step Program

Note: The option to create a new program will not be available if the maximum number of steps or maximum number of programs has already been entered into the controller. The maximum number of steps is 500 and the maximum number of programs is 50 when the controller is configured with a program step type of “24 Hour”. The maximum number of steps is 60 and the maximum number of programs is 20 when the controller is configured with a program step type of “Elapsed”.

To create a new program, use the following procedure:

- 1) Press the **PROGRAM** key.
- 2) Use the ▼ and ▲ keys as necessary to select ‘Create Program’, then press **ENTER**. **Note:** The Program LED flashes when programming.
- 3) Enter the program name. Program names are limited to eight characters in length. The default program name is the current month, followed by the current day, followed by the current year, followed by the current program number. For example, the second program created on October 3, 2001 would have a default name of ‘10030102’. Use the ▼ and ▲ keys as necessary to change characters. If desired, press and hold the ▼ key until the character disappears to add blank characters or to change an existing character to a blank. Press the **PROGRAM** key to advance to the next character. You may repeatedly press the **PROGRAM** key to scroll through and review the program name. Press the **ENTER** key when you have finished entering the program name.
- 4) The user will next be prompted to ‘Add Step’. Press the **ENTER** key to add a new step, or press the ▼ key to select ‘Quit’ and press **ENTER**.
- 5) A single step with default values is inserted as a starting point into every new program. The parameters in this step can then be edited. The user will be prompted to change the step time. The time entry of the step is the time at which the step will begin to run when the program step type is set to “24 Hour”. If the program step type is set to “Elapsed”, the time entry of the step is the step duration in terms of hours and minutes. To change the time setting for the step, press the **ENTER** key. Use the ▼ and ▲ keys as necessary to change the time, then press **ENTER** to accept.
- 6) Press the ▼ key to advance to the next step setting.
- 7) To change the temperature setting for the step, press the **ENTER** key. Use the ▼ and ▲ keys as necessary to change the temperature, then press **ENTER** to accept.
- 8) Press the ▼ key to advance to the next step setting.
- 9) If any other inputs (process loops) are present, enter their step set points. To change the input’s set point, press the **ENTER** key, use the ▼ and ▲ keys as necessary to set the desired value, then press the **ENTER** key to accept the

setting. If no options were ordered, or all desired settings have been made, proceed to step 12).

- 10) Press the ▼ key to advance to the next setting.
- 11) Repeat steps 9) and 10) to adjust day set points for all desired Inputs.
- 12) Press the ▼ key to advance to the next step setting.
- 13) If a lighting option was ordered, the user will be prompted to enter the step's set point for Light 1. If a lighting option was not ordered proceed to step 16). To change the Light 1 setting for the step, press the **ENTER** key. Use the ▼ and ▲ keys as necessary to change the Light 1 setting, then press **ENTER** to accept.

Note (dimnable lighting): The lights will be off when the lighting level is set between 0 and a factory preset threshold value. This limit is based on the minimum output level required to provide stable lighting. Please refer to the operation manual or the supplemental information provided with the operation manual for the threshold value. Any LED model is an exception. A setting of 0 in these models will turn the LEDs off. Any setting greater than 0 will turn the LEDs on.

- 14) Press the ▼ key to advance to the next step setting.
- 15) Repeat steps 13) and 14) for each additional light output ordered.
- 16) Once the last available step parameter has been entered, a screen similar to the following figure will be displayed:

12:00AM	24.0C	70%RH
LT:000		0 PPM

This display indicates the information that was added in the step. In the sample displayed step, the time was set to 12:00AM, the temperature to 24.0C, the humidity level 70%, the auxiliary level to 0PPM and light outputs 1-3 were set to 'Off'. Please note that this display may not include all of the lighting information that is possible for a step. This display can only show up to eight light outputs. If a chamber is equipped with more than eight light outputs, follow the steps below to edit/view a program step, which provides the user with a complete overview of the step's lighting configuration.

To add steps to the program, use the following procedure:

- 1) Press the PROGRAM key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Add Step' and then press ENTER.
- 3) Repeat steps 5-16 from 'create a new program' above to edit each step added. Note: The 'Add Step' option will not be available if the maximum number of steps has been reached.

To review the steps in the program, use the ▼ and ▲ keys as necessary when no step settings are being edited. See step 16 above for an example screen where you can use the ▼ and ▲ keys to review the program steps. If the program step type and operation mode is set to 'Elapsed Non-Ramping' or 'Elapsed Ramping' the current step number navigated to will be displayed for one second.

To edit or review a step's settings, use the following procedure:

- 1) Use the ▼ and ▲ keys as necessary to select the step you wish to edit/review when no step settings are being edited
- 2) Press the PROGRAM key.
- 3) Use the ▼ and ▲ keys as necessary to select 'Edit/View Step' and then press ENTER.
- 4) Use the ▼ and ▲ keys as necessary to view each parameter.
- 5) To change a parameter, press the ENTER key and use the ▼ and ▲ keys as necessary to change the setting, then press ENTER to accept the changes.

To delete a step, use the following process:

- 1) Use the ▼ and ▲ keys as necessary to select the step you wish to delete when no step settings are being edited.
- 2) Once the step is selected, press the PROGRAM key.
- 3) Use the ▼ and ▲ keys as necessary to select 'Delete Step' and then press ENTER.

To quit programming, use the following procedure:

- 1) Press the PROGRAM key when no step settings are being edited.
- 2) Use the ▼ and ▲ keys as necessary to select 'Quit' and then press ENTER. You will return to the main program menu.
- 3) Press the PROGRAM key again to return to the main display.

To run a program, please refer to the section entitled 'Running Programs'.

Editing a Multi-Step Program

Note: This option does not appear when a sequence is running. Any program may be edited, except the current running program. In order to edit the current running program, stop its execution by running manual settings.

To edit a program use the following steps:

- 1) Press the **PROGRAM** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Edit Program' and then press **ENTER**.
- 3) Use the ▼ and ▲ keys as necessary to select the program you wish to edit and then press **ENTER**.
- 4) The user will be prompted to edit the program name. To leave the name the same, press the **ENTER** key. To change the name, use the ▼ and ▲ keys as necessary to change characters. Press the **PROGRAM** key to advance to the next character. Repeatedly press the **PROGRAM** key to scroll through and review the program name. Press the **ENTER** key when finished editing the program name.
- 5) Use the ▼ and ▲ keys as necessary to review each step. If the program step type and operation mode is set to 'Elapsed Non-Ramping' or 'Elapsed Ramping' the current step number navigated to will be displayed for one second.
- 6) If any setting needs to be changed in the selected step, press the **PROGRAM** key.
- 7) Use the ▼ and ▲ keys as necessary to select 'Edit/View Step', then press **ENTER**.
- 8) Use the ▼ and ▲ keys as necessary to view each parameter. To change a parameter, press the **ENTER** key.
- 9) Use the ▼ and ▲ keys as necessary to change the setting, then press **ENTER** to accept.
- 10) To exit the step, continue pressing ▼ or ▲ until the display returns to the step overview screen.
- 11) Add and delete steps by pressing the **PROGRAM** key and selecting the appropriate prompt. **Note:** The 'Add Step' option will not be available if the maximum number of steps has been reached.
- 12) When finished editing, press the **PROGRAM** key. Use the ▼ and ▲ keys as necessary to select 'Quit', then press **ENTER**. The display will return to the program menu.
- 13) Press the **PROGRAM** key to return to the main display.

Deleting a Multi-Step Program

Note: This option does not appear when a sequence is running. Any program may be deleted, except the current running program. In order to delete the current running program, stop the program's execution by running manual settings.

To delete a program use the following process:

- 1) Press the **PROGRAM** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Delete Program' and then press **ENTER**.
- 3) Use the ▼ and ▲ keys as necessary to select the program to be deleted, then press **ENTER**.
- 4) When prompted to confirm deletion, press the **ENTER** key and use the ▼ and ▲ keys as necessary to select 'Yes', then press **ENTER**.
- 5) Press the **PROGRAM** key to return to the main display.

WARNING

Deleting a program that appears in a sequence of programs will cause the entire sequence to be deleted.

Copying a Multi-Step Program

Note: The option to copy a program will not be available if the maximum number of steps or maximum number of programs has been entered into the controller.

To copy a program use the following process:

- 1) Press the **PROGRAM** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Copy Program', then press **ENTER**.
- 3) Use the ▼ and ▲ keys as necessary to select the program to be copied, then press **ENTER**. **Note:** If copying a program would cause the controller to exceed its maximum step limit then this program name will not be available in the list of programs available to copy.
- 4) The user will be prompted to edit the new copied program name. Press the **ENTER** key to start the process of changing the name.
- 5) Use the ▼ and ▲ keys as necessary to change characters. Press the **PROGRAM** key to advance to the next character. Repeatedly press the **PROGRAM** key to scroll through and review the program name.
- 6) Press the **ENTER** key when finished editing the program name.
- 7) The program will now be in edit mode. Change/add/delete steps as necessary to the copied program.
- 14) When finished editing the copied program, press the **PROGRAM** key.
- 15) Use the ▼ and ▲ keys as necessary to select 'Quit', then press **ENTER**.
- 16) The display will return to the main program menu. Press the **PROGRAM** key to return to the main display.

Creating/Editing a Sequence of Multi-Step Programs

Note: This option does not appear when a sequence is running. The controller must either be running manual settings or an individual program in order for this option to appear.

A sequence of programs consists of a list of programs that are scheduled to run in a pre-defined order. Any program that created in the controller can be added to the sequence.

When adding programs to a sequence, the number of iterations each program should run must also be defined. Iterations allow programs in a sequence to loop multiple times before another program is initiated. Once a program finishes running it will either repeat again based on the number of iterations entered or will continue to the next program in the sequence.

An example of a sequence of programs appears below. This program runs a different program each day of the week except for Saturday and Sunday. On Saturday and Sunday the sequence runs the same program, 'Weekend'.

Program Name	Iterations
Monday	1
Tuesday	1
Wednesday	1
Thursday	1
Friday	1
Weekend	2

WARNING

Deleting a program that appears in a sequence of programs will cause the entire sequence to be deleted.

To create a sequence of programs, use the following procedure:

- 1) Press the **PROGRAM** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Create Sequence', then press **ENTER**.
- 3) Press the **ENTER** key and use the ▼ and ▲ keys as necessary to select the program to be added to the sequence, then press **ENTER**.
- 4) Press the ▼ key to advance to the iteration setting.
- 5) Press the **ENTER** key and use the ▼ and ▲ keys as necessary to select the number of iterations the program should run, then press **ENTER**.
- 6) Press the ▼ key to review the added sequence step information.

To view the steps in the sequence, use the ▼ and ▲ keys when a step is not being edited.

To add more steps to the sequence, use the following process:

- 1) Press the **PROGRAM** key and use the ▼ and ▲ keys as necessary to select 'Add Step', then press the **ENTER** key.
- 2) Follow steps 3) through 6) from 'create a sequence of programs' above to add the new program.

To delete a step from the sequence, use the following procedure:

- 1) While in the sequence menu, use the ▼ and ▲ keys as necessary to select the step you wish to delete.
- 2) Press the **PROGRAM** key and use the ▼ and ▲ keys as necessary to select 'Delete Step', then press **ENTER**.

To insert a step into the sequence, use the following procedure:

- 1) While in the sequence menu, use the ▼ and ▲ keys as necessary to select the program step after which the new program step is to be inserted.
- 2) Press the **PROGRAM** key and use the ▼ and ▲ keys as necessary to select 'Insert Step', then press **ENTER**.
- 3) When prompted to select the program, press **ENTER** and use the ▼ and ▲ keys as necessary to select the program to be inserted into the sequence, then press **ENTER**.
- 4) Press the ▼ key to advance to the iteration setting.
- 5) Press the **ENTER** key and use the ▼ and ▲ keys as necessary to select the number of iterations the inserted program is to run, then press **ENTER**.
- 6) Press the ▼ key to review the inserted sequence step information.

To edit a step in the sequence, use the following procedure:

- 1) While in the sequence menu, use the ▼ and ▲ keys as necessary to select the program step to be edited.
- 2) Press the **PROGRAM** key and use the ▼ and ▲ keys as necessary to select 'Edit Step' and then press **ENTER**.
- 3) When prompted, select the program and press **ENTER**.
- 4) Use the ▼ and ▲ keys as necessary to select the program to be run in the step, then press **ENTER**.
- 5) Press the ▼ key to advance to the iteration setting.
- 6) Press the **ENTER** key and use the ▼ and ▲ keys as necessary to select the number of iterations the program is to run, then press **ENTER**.
- 7) Press the ▼ key to review the edited sequence step information.
- 3) When finished programming the sequence, press the **PROGRAM** key and use the ▼ and ▲ keys as necessary to select 'Quit' and then press **ENTER**. Refer to the section titled "Running Programs/Sequence of Programs" for information on running the sequence.

To edit an existing sequence of programs use the following steps:

- 1) Press the **PROGRAM** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Edit Sequence' and then press **ENTER**.
- 3) Use the methods described for creating a sequence above to edit the sequence.

IMPORTANT!

The following guidelines are provided to make sequence programming easier. Please read and be aware of this information before attempting to enter a sequence.

- Write the sequence of programs and number of iterations for each program down before attempting to enter a sequence.
- Use the View Sequence option described below to verify that the sequence has been entered properly.
- If the program step type and operation mode is set to “24 Hour Non-Ramping” or “24 Hour Ramping” - when transitioning from one program to the next in a running sequence the last step of the current program and the first step in the next program are used to determine the set point. In other words, if the last step programmed in the current running program is at 10:00PM and the first step in the next program is at 6:00AM the controller will use these two times as the basis for the set point. If the controller is set to ramp set points, the set point will ramp between the set points at 10:00PM and 6:00AM. It is suggested (not required) that any program used in a sequence have a step entered at 12:00AM. This ensures the initial set point of the new program is properly defined, and helps eliminate any unpredictable results that may occur when running the sequence.
- If the program step type and operation mode is set to “Elapsed Ramping” - when transitioning from one program to the next in a running sequence, the last step of the current program and the first step in the next program are used to determine the set points between which the process loops are ramped.

Viewing a Sequence

To view a programmed sequence, use the following steps:

- 1) Press the **PROGRAM** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'View Sequence', then press **ENTER**.
- 3) Use the ▼ and ▲ keys to review the steps in the sequence.
- 4) Press the **ENTER** key to return to the program menu
- 5) Press the **PROGRAM** key to exit the program menu.

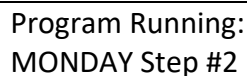
Running a Program / Sequence of Programs

If any program or sequence is in operation, it is recommended that the IntellusUltra controller be set to Manual Mode before any different program or sequence is initiated.

To run a single program, use the following procedure:

- 1) Press the **PROGRAM** key.
- 2) If the program LED is lit because you are currently running a program or sequence, use the ▼ and ▲ keys as necessary to select 'Run Manual' and then press **ENTER**. It is recommended that the IntellusUltra controller be set to Manual Mode before any different program or sequence is initiated. If the program LED is not lit, proceed to step 4).
- 3) Press the **PROGRAM** key to re-enter the program menu.
- 4) Use the ▼ and ▲ keys as necessary to select 'Run Program', then press **ENTER**.
- 5) Use the ▼ and ▲ keys as necessary to select the program you wish to run, then press **ENTER**.
- 6) The Program LED illuminates steadily indicating that the program is running.

Basic information regarding any running program can easily be accessed from the main display on the IntellusUltra. Use the ▼ and ▲ keys as necessary to scroll to the display resembling Figure 7 below.



Program Running:
MONDAY Step #2

Figure 7 – Program Status

To run a sequence of programs use the following steps:

- 1) Press the **PROGRAM** key.
- 2) If the program LED is lit because you are currently running a program or sequence, use the ▼ and ▲ keys as necessary to select 'Run Manual' and then press **ENTER**. It is recommended that the IntellusUltra controller be set to Manual Mode before any different program or sequence is initiated. If the program LED is not lit, proceed to step 4).
- 3) Press the **PROGRAM** key to re-enter the program menu.
- 4) Use the ▼ and ▲ keys as necessary to select 'Run Sequence', then press **ENTER**.
- 5) Use the ▼ and ▲ keys as necessary to select the step from which the sequence should start, then press **ENTER**. This is often the first program added to the sequence.
- 6) Use the ▼ and ▲ keys as necessary to select the iteration of the selected program step from which the sequence should start, then press **ENTER**. This is normally the first iteration.
- 7) The Program LED illuminates steadily indicating the sequence is running.

Basic information regarding any running sequence can easily be accessed from the main display on the IntellusUltra. While in the status menu, view the current point at which a sequence is running by using the ▼ and ▲ keys as necessary to scroll to the display resembling Figure 8 below.

Sequence Running:	
Step #3	Iter:1

Figure 8 – Program Sequence Status

This display shows the current step and iteration of the running sequence. To view the current running program in the sequence, press the ▲ key from this display screen.

Note: The following options are not available when a sequence of programs is running:

- Editing a program
- Deleting a program
- Programming a sequence

The control system must be set to Manual Mode operation before these options are available.

Sample Program

6:00AM – 15.0°C, 60% humidity, one half lights on.
10:00AM - 17.0°C, 65% humidity, all lights on.
2:00PM – 21.0°C, 70% humidity, all lights on.
6:00PM – 24.0°C, 70% humidity, one half lights on.
10:00PM – 21.0°C, 60% humidity, all lights off.

Note: The sample program assumes the chamber was ordered with a humidity option and two light outputs. It also assumes the operation mode is set to non-ramping. The steps necessary to complete an actual program in a given chamber may be different. If a chamber is equipped with less (or additional) options, the displays presenting chamber process values and program information will be different.

Use the following steps as a guide to enter the sample program:

- 1) Press the **PROGRAM** key.
- 2) Use the ▼ and ▲ keys as necessary to select 'Create Program', then press **ENTER**.
- 3) When prompted to "Edit Program Name", press **ENTER** to accept the default name.
- 4) Press the **ENTER** key to "Add Step".
- 5) Press the **ENTER** key. The step time flashes indicating that it can be edited.
- 6) Use the ▼ and ▲ keys as necessary to change the time to 6:00AM, then press **ENTER**.
- 7) Press the ▼ key.
- 8) Press the **ENTER** key. The step temperature flashes indicating that the temperature can be edited.
- 9) Use the ▼ and ▲ keys as necessary to change the temperature to 15.0°C, then press **ENTER**.
- 10) Press the ▼ key.
- 11) Press the **ENTER** key. The step humidity value flashes indicating that the humidity level can be edited.
- 12) Use the ▼ and ▲ keys as necessary to change the humidity level to 60%, then press **ENTER**.
- 13) Press the ▼ key.
- 14) Press the **ENTER** key. The step light 1 value flashes indicating that Light Output 1 can be edited.
- 15) Use the ▼ and ▲ keys as necessary to change the Light 1 value to 'On', then press **ENTER**.
- 16) Press the ▼ key.
- 17) Press the ▼ key again to leave the default light 2 value 'Off'.

The display should read as follows:

6:00AM	15.0C	60%RH
LT:10		

- 18) Press the **PROGRAM** key.
- 19) Use the ▼ and ▲ keys as necessary to select “Add Step”, then press **ENTER**.
- 20) Press the **ENTER** key. The step time flashes indicating that it can be edited.
- 21) Use the ▼ and ▲ keys as necessary to change the time to 10:00AM, then press **ENTER**.
- 22) Press the ▼ key.
- 23) Press the **ENTER** key. The step temperature flashes indicating that the temperature can be edited.
- 24) Use the ▼ and ▲ keys as necessary to change the temperature to 17.0°C, then press **ENTER**.
- 25) Press the ▼ key.
- 26) Press the **ENTER** key. The step humidity value flashes indicating that the humidity level can be edited.
- 27) Use the ▼ and ▲ keys as necessary to change the humidity level to 65%, then press **ENTER**.
- 28) Press the ▼ key.
- 29) Press the ▼ key again to leave the default light 1 value ‘On’.
- 30) Press the **ENTER** key. The step’s Light Output 2 value flashes indicating that it can be edited.
- 31) Use the ▼ and ▲ keys as necessary to change the light 2 value to ‘On’, then press **ENTER**.
- 32) Press the ▼ key.

The display should read as follows:

10:00AM	17.0C	65%RH
LT:11		

- 33) Press the **PROGRAM** key.
- 34) Use the ▼ and ▲ keys as necessary to select “Add Step”, then press **ENTER**.
- 35) Press the **ENTER** key. The step time flashes indicating that it can be edited.
- 36) Use the ▼ and ▲ keys as necessary to change the time to 2:00PM, then press **ENTER**.
- 37) Press the ▼ key.
- 38) Press the **ENTER** key. The step temperature flashes indicating that the temperature can be edited.
- 39) Use the ▼ and ▲ keys as necessary to change the temperature to 21.0°C, then press **ENTER**.
- 40) Press the ▼ key.

- 41) Press the **ENTER** key. The step humidity value flashes indicating that the humidity level can be edited.
- 42) Use the ▼ and ▲ keys as necessary to change the humidity level to 70%, then press **ENTER**.
- 43) Press the ▼ key.
- 44) Press the ▼ key again to leave the default light 1 value 'On'.
- 45) Press the ▼ key again to leave the default light 2 value 'On'.
- 46) Press the ▼ key.

The display should read as follows:

2:00PM	21.0C	70%RH
LT:11		

- 47) Press the **PROGRAM** key.
- 48) Use the ▼ and ▲ keys as necessary to select "Add Step", then press **ENTER**.
- 49) Press the **ENTER** key. The step time flashes indicating that it can be edited.
- 50) Use the ▼ and ▲ keys as necessary to change the time to 6:00PM, then press **ENTER**.
- 51) Press the ▼ key.
- 52) Press the **ENTER** key. The step temperature flashes indicating that the temperature can be edited.
- 53) Use the ▼ and ▲ keys as necessary to change the temperature to 24.0°C, then press **ENTER**.
- 54) Press the ▼ key.
- 55) Press the ▼ key again to leave the default humidity value at '70%'.
- 56) Press the ▼ key again to leave the default light 1 value 'On'.
- 57) Press the **ENTER** key. The step's Light Output 2 value flashes indicating that it can be edited.
- 58) Use the ▼ and ▲ keys as necessary to change the light 2 value to 'Off', then press **ENTER**.
- 59) Press the ▼ key.

The display should read as follows:

6:00PM	24.0C	70%RH
LT:10		

- 60) Press the **PROGRAM** key.
- 61) Use the ▼ and ▲ keys as necessary to select "Add Step", then press **ENTER**.
- 62) Press the **ENTER** key. The step time flashes indicating that it can be edited.
- 63) Use the ▼ and ▲ keys as necessary to change the time to 10:00PM, then press **ENTER**.
- 64) Press the ▼ key.

- 65) Press the **ENTER** key. The step temperature flashes indicating that the temperature can be edited.
- 66) Use the ▼ and ▲ keys as necessary to change the temperature to 21.0°C, then press **ENTER**.
- 67) Press the ▼ key.
- 68) Press the **ENTER** key. The step humidity value flashes indicating that the humidity level can be edited.
- 69) Use the ▼ and ▲ keys as necessary to change the humidity level to 60%, then press **ENTER**.
- 70) Press the ▼ key.
- 71) Press the **ENTER** key. The step's Light Output 1 value flashes indicating that it can be edited.
- 72) Use the ▼ and ▲ keys as necessary to change the light 1 value to 'Off', then press **ENTER**.
- 73) Press the ▼ key.
- 74) Press the ▼ key again to leave the default light 2 value 'Off'.

The display should read as follows:

10:00PM	21.0C	60%RH
LT:00		

To review the program, use the following procedure:

- 1) Use the ▼ and ▲ keys as necessary to review the program. If any program steps need to be changed, continue to the next step. If no steps need editing, continue to step 5).
- 2) Press the **PROGRAM** key.
- 3) Use the ▼ and ▲ keys as necessary to select 'Edit Step'.
- 4) Follow steps 7) through 10) from 'Editing a Multi-step Program' above.
- 5) When finished reviewing the program, press the **PROGRAM** key.
- 6) Use the ▼ and ▲ keys as necessary to select 'Quit', then press **ENTER**. Refer to the section titled "Running Programs" for information on running the sample program.

Defrost Programming (optional)

When a low temperature option is ordered, or a chamber requires defrost periods for proper operation, the IntellusUltra controller is configured with a defrost function. Most chambers are not provided with a defrost system. Please refer to any supplemental information provided with the operation manual. This information will indicate whether or not defrost programming is provided/necessary.

Certain chambers are configured for automatic defrost and utilize two cooling coils. In this case, the IntellusUltra controller is not configured for defrosting. To see if your controller is configured for defrosting, follow the steps listed below. If the 'Number Of Defrosts' prompt does not appear then your chamber has been set up for automatic defrosting.

When the controller is configured for defrosting, up to six defrost periods may be programmed over a twenty-four hour period. When constantly running low temperatures, Percival Scientific recommends that two seven minute periods be programmed twelve hours apart. The number of and/or duration of periods may need to be adjusted. The necessity for programming defrost periods can be gauged by observing the inability of the chamber to hold the set point at low temperatures.

To program defrost periods, use the following steps:

- 1) Press the **INPUTS** key.
- 2) Press the **ENTER** key to select the 'TEMP' input.
- 3) Use the ▼ key as necessary to select 'Number Of Defrosts'. If this prompt does not appear, then the chamber has not been configured for automatic defrost.
- 4) Press the **ENTER** key. Use the ▼ and ▲ keys as necessary to select the number of defrost periods required, then press the **ENTER** key.
- 5) Press the ▼ key. The user will be prompted to enter the 'Defrost Duration'.
- 6) Press the **ENTER** key. Use the ▼ and ▲ keys as necessary to set the duration of each defrost period, then press the **ENTER** key.
- 7) Press the ▼ key. The user will be prompted to enter the 'Defrost 1 Start'. This is the time that the first defrost period will start.
- 8) Press the **ENTER** key. Use the ▼ and ▲ keys as necessary to set the start time of the first defrost period, then press the **ENTER** key. If the Defrost feature has been configured for more than one defrost period, continue to the next step.
- 9) Press the ▼ key to advance to the next period.
- 10) Press the **ENTER** key. Use the ▼ and ▲ keys as necessary to set the start time of the defrost period, then press the **ENTER** key.
- 11) Repeat steps 10) and 11) above for any additional defrost periods.

- 12) Once start times have been set for each configured defrost period, press the **INPUTS** key to exit the Inputs menu. The chamber will now defrost at the times selected for the configured duration.

Note: The chamber will not defrost unless the temperature is below a preset value determined by Percival Scientific. This value is typically 4°C.

Calibration Offsets

⚠ CAUTION

Calibration offsets are not normally altered. Calibration offsets should only be changed when the temperature, humidity or auxiliary values displayed on the controller do not agree with your measurement device.

Every chamber is calibrated at 25°C with all lights on and all lights off before it's shipped from Percival Scientific's factory. If any chamber process values (such as temperature or humidity) disagree with your measurement standard, the calibration offsets can be adjusted. Multiple day and night offsets are available for temperature. Single day and night offsets are available for temperature, temperature limit 2, humidity (if ordered), auxiliary (if ordered), and any expansion channels (if ordered). The Day Offset value is applied to the process value when any light output is on. The Night Offset will be applied to the process value when all light outputs are off. The value entered for each calibration offset is added to the input's process value, and the adjusted new value is displayed and used for control. For example, if a thermometer placed in the chamber at the location of an experiment reads 26.3°C and the IntellusUltra controller reads 26.0°C, then the calibration offset should be set to 0.3°C so that the process value in the controller matches the measured value from the calibration standard. Calibration offsets cannot be set while programming.

In most cases, a single day and night offset is sufficient. However, multiple temperature offsets are available for use at the user's discretion. Multi-point calibrations are typically most suitable for experiments with very wide temperature swings (approaching the limits of a chamber's specified temperature operating range). As the temperature process value moves farther away from the single calibration point of 25°C, the probe's output can 'drift' out of calibration. When this is observed, a multi-point temperature calibration is appropriate, where day and night offsets can be entered at three temperatures. For example, if an experiment is designed to operate over a range 4°C to 40°C, day and night offsets can be entered at 4°C, 25°C and 40°C. Below 4°C, the 4°C offset is applied. Between 4°C and 25°C, the applied offset is a linearly interpolated value between the 4°C and 25°C offset values. At 25°C, the 25°C offset is applied.

Between 25°C and 40°C, the applied offset is a linearly interpolated value between the 25°C and 40°C offset values. Above 40°C, the 40°C offset is applied.

If the chamber needs to be calibrated to a different standard measurement device, use the following steps as a guide:

- 1) Turn all lights off in the chamber
- 2) Position the new standard measurement device in the area of the chamber of most interest/importance to the experiment
- 3) Set the chamber to 'Manual' mode, and set the manual set points to the desired calibration value(s).
- 4) Let the chamber run for approximately 20-30 minutes to allow the system to stabilize.
- 5) Compare the IntellusUltra process value to the value output from the standard, and enter the **difference** between the two into the night calibration offset menu. For example: If the IntellusUltra controller is reading 30°C and the temperature standard reads 28°C, then enter -2.0°C into the night temperature offset menu. This will offset the IntellusUltra temperature readout so that it agrees with the standard. Entering -2.0°C will change the readout from the IntellusUltra display to 28°C from the previous 30°C. Refer to the information below for information on setting the temperature offsets.
- 6) At this point the IntellusUltra controller is re-calibrated to the new standard for night mode (all lights off). Repeat steps 1 through 5, running the chamber in day mode (all lights on), and enter the calibration offset into the day calibration offset.

To adjust the temperature offsets using a single day/night offset use the following steps:

- 1) Press and hold both the **ENTER** and **INPUTS** keys for approximately 3 seconds until the display changes to read 'Select Offset'. **Note:** Always press and hold the **ENTER** key before pressing and holding the **INPUTS** key.
- 2) Press the **ENTER** key to enter the 'TEMP' offset menu.
- 3) If the Multiple Offsets value is set to 'No', press the ▼ key. If the Multiple Offsets value is set to 'Yes', press the **ENTER** key and use the ▼ and ▲ keys as necessary to select 'No' and then press **ENTER**. Next, press the ▼ key.
- 4) Press the **ENTER** key and use the ▼ and ▲ keys as necessary to change the 'Day Temp Offset', then press **ENTER**.
- 5) Press the ▼ key to select 'Night Temp Offset', then press **ENTER**.
- 6) Use the ▼ and ▲ keys as necessary to change the night offset, then press **ENTER**.
- 7) Press the **INPUTS** key to return to the main display.

The above example should be applied when using a single day/night offset for temperature. If multiple temperature offsets are required, decide upon the three temperatures at which the calibrations should occur, then enter those values into the day and night temperature 1-3 settings (see below). Operate the chamber at the three temperature settings with lights on and lights off to determine the offsets.

To adjust the temperature offsets using multiple day/night offsets use the following steps:

- 1) Press and hold both the **ENTER** and **INPUTS** keys for approximately 3 seconds until the display changes to read 'Select Offset'. **Note:** Always press and hold the **ENTER** key before pressing and holding the **INPUTS** key.
- 2) Press the **ENTER** key to enter the 'TEMP' offset menu.
- 3) If the Multiple Offsets value is set to 'Yes', press the ▼ key. If the Multiple Offsets value is set to 'No', press the **ENTER** key and use the ▼ and ▲ keys as necessary to select 'Yes' and then press **ENTER**. Next, press the ▼ key.
- 4) Press the **ENTER** key and use the ▼ and ▲ keys as necessary to change the 'Temp Offset 1 Day' value, then press **ENTER**. This is the offset that will be applied at Temp Point 1 Day which is set below.
- 5) Press the ▼ key to select 'Temp Offset 2 Day', then press **ENTER**.
- 6) Use the ▼ and ▲ keys as necessary to change the offset, then press **ENTER**. This is the offset that will be applied at Temp Point 2 Day which is set below.
- 7) Press the ▼ key to select 'Temp Offset 3 Day', then press **ENTER**.
- 8) Use the ▼ and ▲ keys as necessary to change the offset, then press **ENTER**. This is the offset that will be applied at Temp Point 3 Day which is set below.
- 9) Press the ▼ key to select 'Temp Offset 1 Night' and then press **ENTER**.
- 10) Use the ▼ and ▲ keys as necessary to change the offset, then press **ENTER**. This is the offset that will be applied at Temp Point 1 Night which is set below.
- 11) Press the ▼ key to select 'Temp Offset 2 Night', then press **ENTER**.
- 12) Use the ▼ and ▲ keys as necessary to change the offset, then press **ENTER**. This is the offset that will be applied at Temp Point 2 Night which is set below.
- 13) Press the ▼ key to select 'Temp Offset 3 Night', then press **ENTER**.
- 14) Use the ▼ and ▲ keys as necessary to change the offset, then press **ENTER**. This is the offset that will be applied at Temp Point 3 Night which is set below.
- 15) Press the ▼ key to select 'Temp Point 1 Day', then press **ENTER**.
- 16) Use the ▼ and ▲ keys as necessary to change the temperature, then press **ENTER**. This is the temperature at which Temp Offset 1 Day will be applied.
- 17) Press the ▼ key to select 'Temp Point 2 Day', then press **ENTER**.
- 18) Use the ▼ and ▲ keys as necessary to change the temperature, then press **ENTER**. This is the temperature at which Temp Offset 2 Day will be applied.
- 19) Press the ▼ key to select 'Temp Point 3 Day', then press **ENTER**.

- 20) Use the ▼ and ▲ keys as necessary to change the temperature, then press **ENTER**. This is the temperature at which Temp Offset 3 Day will be applied.
- 21) Press the ▼ key to select 'Temp Point 1 Night', then press **ENTER**.
- 22) Use the ▼ and ▲ keys as necessary to change the temperature, then press **ENTER**. This is the temperature at which Temp Offset 1 Night will be applied.
- 23) Press the ▼ key to select 'Temp Point 2 Night', then press **ENTER**.
- 24) Use the ▼ and ▲ keys as necessary to change the temperature, then press **ENTER**. This is the temperature at which Temp Offset 2 Night will be applied.
- 25) Press the ▼ key to select 'Temp Point 3 Night', then press **ENTER**.
- 26) Use the ▼ and ▲ keys as necessary to change the temperature, then press **ENTER**. This is the temperature at which Temp Offset 3 Night will be applied.
- 27) Press the **INPUTS** key to return to the main display.

The limit 2 sensor is an independent probe which is typically configured for use as a backup to the primary temperature sensor (Limit 1). This sensor measures the temperature in the chamber and allows users to set alarm limits which will trigger a limit alarm (see Alarms section) if the temperature exceeds the configured alarm thresholds. The limit 2 sensor should be calibrated to match the main temperature reading.

Note: An exception to this is when a dew chamber has been ordered. The dew chamber uses the limit 2 sensor to measure the chamber air temperature and the main temperature sensor measures the wall temperature. **Do not use the following procedure to calibrate limit 2 on a dew chamber.**

The limit 2 sensor should be calibrated to match the main temperature reading when lights are both on (day mode) and off (night mode). All of the lights should be turned on in order to determine the day offset that should be applied. The main temperature reading is displayed in tenths. The limit 2 reading is displayed in whole numbers. To compare the main temperature reading to the limit 2 reading first note the temperature displayed on the main display. For example, the main temperature is 24.3C in the sample display below.

3:30PM	24.3C	75%RH
LT:110		800PPM

Main Display

To view the current limit 2 reading, press the ▲ key once from the main display.

Limit 2	26C
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Limit 2 Reading

In the example above, the limit 2 reading is 1.7C higher than the main temperature reading. To adjust the limit 2 reading always round up the main reading to the nearest whole number and subtract that number from the limit 2 reading. In the example, you'd round 24.3C to 25C and then subtract that from 26C. Hence, you'd use an offset of -1C for limit 2.

If the main temperature reading is a negative number, round up to the next negative whole number. For example, if the main reading was -2.1C round that number to -3C and use this value as reference for determining the limit 2 offset.

To adjust the limit 2 offsets use the following steps:

- 1) Press and hold both the **ENTER** and **INPUTS** keys for approximately 3 seconds until the display changes to read 'Select Offset'. **Note:** Always press and hold the **ENTER** key before pressing and holding the **INPUTS** key.
- 2) Press the **ENTER** key to enter the 'TEMP' offset menu.
- 3) Repeatedly press and release the ▼ key until 'Limit 2 Day Offset' is displayed.
- 4) Press the **ENTER** key and use the ▼ and ▲ keys as necessary to change the 'Limit 2 Day Offset' value, then press **ENTER**.
- 5) Press the ▼ key to select 'Limit 2 Night Offset', then press **ENTER**.
- 6) Use the ▼ and ▲ keys as necessary to change the night offset, then press **ENTER**.
- 7) Press the **INPUTS** key to return to the main display.

To adjust the offsets for any additional Inputs (as applicable) use the following steps:

- 1) Press and hold both the **ENTER** and **INPUTS** keys for approximately 3 seconds until the display changes to read 'Select Offset'. **Note:** Always press and hold the **ENTER** key before pressing and holding the **INPUTS** key.
- 2) Use the ▼ and ▲ keys as necessary to select the desired Input channel (such as 'RH' or 'CO2') and then press **ENTER** to access the offset menu.
- 3) Press the **ENTER** key and use the ▼ and ▲ keys as necessary to change the 'X Offset Day' value, where X is the Input Name, then press **ENTER**.
- 4) Press the ▼ key to select 'X Offset Night', where X is the Input Name, then press **ENTER**.
- 5) Use the ▼ and ▲ keys as necessary to change the offset, then press **ENTER**.
- 6) Press the **INPUTS** key to return to the main display.

Diagnostics Menu

The diagnostics menu contains an overview of information that is helpful in determining the current state in which the controller is operating. It is also used for troubleshooting potential issues with Percival Scientific's support staff. You may be asked to refer to this menu when contacting Percival Scientific for support.

The diagnostics menu contains the following read-only information:

- **Service Phone Number** – Percival Scientific's toll-free contact phone number
- **Chamber Serial Number** – This information is entered by Percival Scientific and is needed when calling in for support.
- **Chamber Model** – This information is entered by Percival Scientific.
- **Firmware Revision** – The revision number of the controller's firmware.
- **Alarm Status** – Displays whether or not an alarm is currently occurring on the controller.
- **Time** – Current system time.
- **Last Power Up Time** – Displays the date and time that the chamber was last powered.
- **Program Type** – Displays the program step type and operation mode that is currently configured on the controller. Refer to the section titled, "Setting Program Step Type and Operation Mode" for more information.
- **Program Mode** – Displays the current operation mode the controller is running (manual, diurnal, program, sequence, etc.).
- **Program Name** – Displays the name of the current running program, if a program or sequence is running.
- **Limit 1 High Alarm** – Displays the limit 1 high alarm setting.
- **Limit 1 Low Alarm** – Displays the limit 1 low alarm setting.
- **Limit 2 High Alarm** – Displays the limit 2 high alarm setting.
- **Limit 2 Low Alarm** – Displays the limit 2 low alarm setting.
- **Multiple Offsets** – Displays whether or not multiple offsets are configured for temperature.
- **TEMP Offset Day** – Displays the current offset being applied to the temperature input, if the controller is in day mode (any light on).
- **RH Offset Day (only appears when humidification system is ordered)** – Displays the current offset being applied to the humidity input, if the controller is in day mode (any light on).
- **AUX Offset Day (only appears when auxiliary system is ordered)** – Displays the current offset being applied to the auxiliary input, if the controller is in day mode (any light on).
- **RMC4 Offset Day (only appears when an expansion module populated with channel 4 is provided)** – Displays the current offset being applied to expansion input 4, if the controller is in day mode (any light on).

- **RMC5 Offset Day (only appears when an expansion module populated with channel 5 is provided)** – Displays the current offset being applied to expansion input 5, if the controller is in day mode (any light on).
- **RMC6 Offset Day (only appears when an expansion module populated with channel 6 is provided)** – Displays the current offset being applied to expansion input 6, if the controller is in day mode (any light on).
- **RMC7 Offset Day (only appears when an expansion module populated with channel 7 is [provided])** – Displays the current offset being applied to expansion input 7, if the controller is in day mode (any light on).
- **TEMP Offset Night** – Displays the current offset being applied to the temperature input, if the controller is in night mode (all lights off).
- **RH Offset Night (only appears when humidification system is ordered)** – Displays the current offset being applied to the humidity input, if the controller is in night mode (all lights off).
- **AUX Offset Night (only appears when auxiliary system is ordered)** – Displays the current offset being applied to the auxiliary input, if the controller is in night mode (all lights off).
- **RMC4 Offset Night (only appears when an expansion module populated with channel 4 is provided)** – Displays the current offset being applied to expansion input 4, if the controller is in night mode (all lights off).
- **RMC5 Offset Night (only appears when an expansion module populated with channel 5 is provided)** – Displays the current offset being applied to expansion input 5, if the controller is in night mode (all lights off).
- **RMC6 Offset Night (only appears when an expansion module populated with channel 6 is provided)** – Displays the current offset being applied to expansion input 6, if the controller is in night mode (all lights off).
- **RMC7 Offset Night (only appears when an expansion module populated with channel 7 is provided)** – Displays the current offset being applied to expansion input 7, if the controller is in night mode (all lights off).
- **RH ChA Enabled (only appears when humidification system is ordered)** – Displays if the humidification system is enabled (Yes) or disabled (No) in the inputs menu.
- **RH ChB Enabled (only appears when dehumidification system is ordered)** – Displays if the dehumidification system is enabled (Yes) or disabled (No) in the inputs menu.
- **AUX ChA Enabled (only appears when auxiliary system is ordered - may not appear depending on the auxiliary system ordered)** – Displays if the auxiliary channel A output is enabled (Yes) or disabled (No) in the inputs menu.
- **AUX ChB Enabled (only appears when auxiliary system is ordered - may not appear depending on the auxiliary system ordered)** – Displays if the auxiliary channel B output is enabled (Yes) or disabled (No) in the inputs menu.

- **RMC4 ChA Enabled (only appears when an expansion module populated with channel 4 is provided - may not appear depending on the auxiliary system ordered)** – Displays if the expansion channel A output is enabled (Yes) or disabled (No) in the inputs menu.
- **RMC4 ChB Enabled (only appears when an expansion module populated with channel 4 is provided - may not appear depending on the auxiliary system ordered)** – Displays if the expansion channel B output is enabled (Yes) or disabled (No) in the inputs menu.
- **RMC5 ChA Enabled (only appears when an expansion module populated with channel 5 is provided - may not appear depending on the auxiliary system ordered)** – Displays if the expansion channel A output is enabled (Yes) or disabled (No) in the inputs menu.
- **RMC5 ChB Enabled (only appears when an expansion module populated with channel 5 is provided - may not appear depending on the auxiliary system ordered)** – Displays if the expansion channel B output is enabled (Yes) or disabled (No) in the inputs menu.
- **RMC6 ChA Enabled (only appears when an expansion module populated with channel 6 is provided - may not appear depending on the auxiliary system ordered)** – Displays if the expansion channel A output is enabled (Yes) or disabled (No) in the inputs menu.
- **RMC6 ChB Enabled (only appears when an expansion module populated with channel 6 is provided - may not appear depending on the auxiliary system ordered)** – Displays if the expansion channel B output is enabled (Yes) or disabled (No) in the inputs menu.
- **RMC7 ChA Enabled (only appears when an expansion module populated with channel 7 is provided - may not appear depending on the auxiliary system ordered)** – Displays if the expansion channel A output is enabled (Yes) or disabled (No) in the inputs menu.
- **RMC7 ChB Enabled (only appears when an expansion module populated with channel 7 is provided - may not appear depending on the auxiliary system ordered)** – Displays if the expansion channel B output is enabled (Yes) or disabled (No) in the inputs menu.
- **Number of Defrosts (only appears if low temperature option with controller based defrost is ordered)** – Displays the number of defrost periods configured in the inputs menu. Refer to the section titled, “Defrost Programming” for more information.
- **Ambient Temp** – Displays the approximate ambient temperature in which the IntellusUltra controller is operating.
- **IP Address Mode (only appears if IntellusUltraConnect controller is ordered)** – Displays the current IP method configured for the controller. Refer to the section titled, “IP Address Setup” for more information.

- **Active IP Address (only appears if IntellusUltraConnect controller is ordered)** – Displays the current active IP address. Refer to the section titled, “IP Address Setup” for more information.
- **Active IP Subnet (only appears if IntellusUltraConnect controller is ordered)** – Displays the current active IP subnet mask. Refer to the section titled, “IP Address Setup” for more information.
- **Active IP Gateway (only appears if IntellusUltraConnect controller is ordered)** – Displays the current active IP default gateway address. Refer to the section titled, “IP Address Setup” for more information.
- **MAC Address (only appears if IntellusUltraConnect controller is ordered)** – Displays the MAC address for the controller. Refer to the section titled, “IP Address Setup” for more information.
- **Network Status (only appears if IntellusUltraConnect controller is ordered)** – Displays the status of the network connection. The connection speed is displayed upon successful connection to a network.
- **SD Memory Card (only appears if IntellusUltraConnect controller is ordered)** – Displays if a SD card is installed. This card is required for data logging. The SD card is preinstalled at the factory. Refer to the section titled, “Data Log” for more information.
- **Security Level** – Displays the current security level of the user. Refer to the section titled, “Configuring Security” for more information.

Data Log (IntellusUltra Connect Only)

If an IntellusUltraConnect controller was ordered, data is automatically logged every minute to an onboard SD card. This card is preinstalled at the factory. The end user can export up to one year’s worth of data at any time using a customer supplied USB flash drive. The data is exported as a single CSV (comma separated values) file that can be directly imported into Microsoft Excel or similar software. The first row of the exported file contains header information for the parameters logged.

Percival Scientific recommends the SanDisk Ultra USB 3.0 flash drive for best performance when accessing data logs.



USB flash drive

The data that is exported contains the following information:

- Date and time of logged point (Year, Month, Day, Hour, Minute)
- Program operation mode (Mode)
- Program name (Prog_Name)
- Program step number (Prog_Step)
- Sequence step number (Seq_Step)
- Sequence iteration (Seq_Iter)
- Temperature process value (PV_1)
- Temperature set point (SP_1)
- Humidity process value (PV_2) - only appears if humidification or dehumidification system was ordered
- Humidity set point (SP_2) - only appears if humidification or dehumidification system was ordered
- Auxiliary process value (PV_3) - only appears if auxiliary system was ordered
- Auxiliary set point (SP_3) - only appears if auxiliary system was ordered
- Expansion Slot 4 process value (PV_4) – only appears if this channel is enabled on the control system
- Expansion Slot 4 set point (SP_4) – only appears if this channel is enabled on the control system
- Expansion Slot 5 process value (PV_5) – only appears if this channel is enabled on the control system
- Expansion Slot 5 set point (SP_5) – only appears if this channel is enabled on the control system
- Expansion Slot 6 process value (PV_6) – only appears if this channel is enabled on the control system
- Expansion Slot 6 set point (SP_6) – only appears if this channel is enabled on the control system
- Expansion Slot 7 process value (PV_7) – only appears if this channel is enabled on the control system
- Expansion Slot 7 set point (SP_7) – only appears if this channel is enabled on the control system
- Light output data for outputs 1-47 (EO_1 through EO_47 as applicable)
- Limit 2 process value (Lim_2_PV)
- Defrost status (Defrost) - only appears if low temperature option with controller based defrost is ordered
- DLI daily light integral value (DLI) - only appears if closed loop dimmable lighting was ordered
- DLI daily light accrued value (DLI_Acc) - only appears if closed loop dimmable lighting was ordered
- Limit 1 high alarm set point (Lim_1_Hi)
- Limit 1 low alarm set point (Lim_1_Lo)
- Limit 2 high alarm set point (Lim_2_Hi)

- Limit 2 low alarm set point (Lim_2_Lo)
- Temperature alarm high set point (Alm_1_Hi) – only appears if enabled on controller
- Temperature alarm low set point (Alm_1_Lo) – only appears if enabled on controller
- Humidity alarm high set point (Alm_2_Hi) – only appears if Input is provided, and enabled on controller
- Humidity alarm low set point (Alm_2_Lo) – only appears if Input is provided, and enabled on controller
- Auxiliary alarm high set point (Alm_3_Hi) – only appears if Input is provided, and enabled on controller
- Auxiliary alarm low set point (Alm_3_Lo) – only appears if Input is provided, and enabled on controller
- Channel 4 alarm high set point (Alm_4_Hi) – only appears if Input is provided, and enabled on controller
- Channel 4 alarm low set point (Alm_4_Lo) – only appears if Input is provided, and enabled on controller
- Channel 5 alarm high set point (Alm_5_Hi) – only appears if Input is provided, and enabled on controller
- Channel 5 alarm low set point (Alm_5_Lo) – only appears if Input is provided, and enabled on controller
- Channel 6 alarm high set point (Alm_6_Hi) – only appears if Input is provided, and enabled on controller
- Channel 6 alarm low set point (Alm_6_Lo) – only appears if Input is provided, and enabled on controller
- Channel 7 alarm high set point (Alm_7_Hi) – only appears if Input is provided, and enabled on controller
- Channel 7 alarm low set point (Alm_7_Lo) – only appears if Input is provided, and enabled on controller
- Light lifetime alarm set point (Light_Life)
- Limit 1 alarm status (Lim_1_Alarm)
- Limit 2 alarm status (Lim_2_Alarm)
- Deviation alarm status (Dev_Alarm)
- Temperature alarm status (Alm_1_Alarm) – only appears if enabled on controller
- Humidity alarm status (Alm_2_Alarm) – only appears if Input is provided, and enabled on controller
- Auxiliary alarm status (Alm_3_Alarm) – only appears if Input is provided, and enabled on controller
- Channel 4 alarm status (Alm_4_Alarm) – only appears if Input is provided, and enabled on controller
- Channel 5 alarm status (Alm_5_Alarm) – only appears if Input is provided, and enabled on controller

- Channel 6 alarm status (Alm_6_Alarm) – only appears if Input is provided, and enabled on controller
- Channel 7 alarm status (Alm_7_Alarm) – only appears if Input is provided, and enabled on controller
- Light lifetime alarm status (Life_Alarm)
- Humidification enabled status (Ch2A_Ena) - only appears if humidification system was ordered
- Dehumidification enabled status (Ch2B_Ena) - only appears if dehumidification system was ordered
- Auxiliary channel A enabled status (Ch3A_Ena) - may not appear depending on the auxiliary system ordered
- Auxiliary channel B enabled status (Ch3B_Ena) - may not appear depending on the auxiliary system ordered
- Expansion Slot 4 channel A enabled status (Ch4A_Ena) – may not appear depending on the channel's configuration
- Expansion Slot 4 channel B enabled status (Ch4B_Ena) – may not appear depending on the channel's configuration
- Expansion Slot 5 channel A enabled status (Ch5A_Ena) – may not appear depending on the channel's configuration
- Expansion Slot 5 channel B enabled status (Ch5B_Ena) – may not appear depending on the channel's configuration
- Expansion Slot 6 channel A enabled status (Ch6A_Ena) – may not appear depending on the channel's configuration
- Expansion Slot 6 channel B enabled status (Ch6B_Ena) – may not appear depending on the channel's configuration
- Expansion Slot 7 channel A enabled status (Ch7A_Ena) – may not appear depending on the channel's configuration
- Expansion Slot 7 channel B enabled status (Ch7B_Ena) – may not appear depending on the channel's configuration
- Light lifetime values for outputs 1-47 (Light1_Life through Light47_Life as applicable)

To export data to a USB flash drive:

- 1) Insert a USB flash drive into the USB port provided on the chamber ⁽¹⁾.
- 2) Press the **DATA LOG** key.
- 3) At the “Number of Days” prompt ⁽²⁾, press the **ENTER** key and use the ▼ and ▲ keys as necessary to select the number of days of data to be exported. Between 1 and 365 days' worth of data ⁽³⁾ can be exported.
- 4) Press the ▼ key.
- 5) At the “Export Data?” prompt, press the **ENTER** key and use the ▼ and ▲ keys as necessary to change the “Export Data?” prompt from ‘No’ to ‘Yes’.

The data will start exporting to the USB flash drive. A status display similar to the following provides the export status.

File Transfer
Day: 1 Min: 831

The export process exports data one minute at a time, for each day exported. There are a total of 1440 minutes in a day so the current day being exported will be displayed along with the current minute in the day. When the export has completed the display will show:

File Transfer
Transfer Success

At this point the USB flash drive may be removed. Import the file using a computer with Microsoft Excel or similar software. To clear this message, press the **DATA LOG** key.

If it becomes necessary to cancel the data transfer process:

- 1) While data is transferring, press the **DATA LOG** key.
- 2) At the “Stop Data Transfer?” prompt, press the **ENTER** key and use the ▼ and ▲ keys as necessary to change the “Stop Data Transfer?” prompt from ‘No’ to ‘Yes’

The file name of the exported data on the USB flash drive will consist of the chamber serial number and the date the data was exported. For example, a chamber with a serial number of 20000.01.14A exported on 4/10/2014 will have a file name of 020000_01_14A04_10_2014.csv. This allows users to identify the chamber when exporting data from more than one chamber. The chamber’s serial number can be referenced in the Diagnostics menu. Refer to the section titled “Diagnostics” for more information. If data is exported more than once on the same day, the file will be overwritten.

When opening the exported file in Excel or similar software, some fields may show exported data values of ‘0’ for some rows of parameters. The data export process exports all minutes in a given day, even if the time of day hasn’t yet been reached. For example, an exporting of the current day’s data will contain rows for 12:00AM to 11:59PM. If the export occurred at 4:30PM, the rows for 4:31PM to 11:59PM will contain ‘0’ for all parameters. This will also happen if more days are exported than have actually been logged. For example, if a new chamber has been in operation for only 3 days and the previous 10 days’ worth of data was requested in a data export, ‘0’ will be present for all parameters for the first 7 days of data log, where no data actually exists.

Any time period where the chamber has been turned off will also report '0' for parameters for the length of time the chamber was off.

- (1) The age and type of USB flash drive used can affect the amount of time it takes to export the data log. Typically it takes approximately one minute to export one day's worth of data. If you notice it is taking much longer than this to export one day's worth of data, use the procedure described above to cancel the data log transfer and use a different USB flash drive. Typically it has been found that newer USB flash drives work faster than older drives (see Percival's recommended USB flash drive above for best performance).
- (2) If you are not presented with the "Number of Days" prompt, the controller does not recognize the USB flash drive. The USB flash drive must be formatted in the FAT32 format. If you are not prompted, try a different flash drive.
- (3) It is recommended that users regularly export their data. Regularly exporting the data in smaller chunks may be preferable to waiting a long time for a large set of data. Percival Scientific recommends that data is exported on a weekly or daily schedule.

Please note that the SD card which holds the data has a finite number of times to which it can be written. When it reaches the end of its life, data will either export corrupted or will not export at all. If you are having issues exporting the data, first try a different USB flash drive and if the new drive fails to work, replace the SD card. Please contact Percival Scientific for assistance in replacing the SD card.

Please note that data may be corrupted if the chamber is powered off when data is being written to the SD card. This may corrupt a single point of data or may corrupt an entire day's worth of data. There is nothing that can be done to prevent this possible scenario. If you need to turn the chamber off, export the data log before powering down the chamber. When the chamber is powered back up, export the log again and check for corruption.

User Setup Menu

The User Setup Menu is a password-protected menu which contains system-level settings that do not frequently need to be accessed during normal operation. These settings include day/date/time, programming modes, communications configuration, and security level passcodes.

CAUTION

Modification of any settings contained within the User Setup Menu can significantly affect the operation of the entire control system, and any in-process experiments inside the environmental chamber. Do not change any User Setup Menu settings unless certain it is okay to do so.

The User Setup Menu contains the following control system settings:

- **Change Lvl1 Password** – This parameter sets the level 1 security password
- **Change Lvl2 Password** – This parameter sets the level 2 security password
- **Change Lvl3 Password** – This parameter sets the level 3 security password
- **Change Slvl Password** – This parameter sets the security level password
- **Program Type** – This parameter sets the control system's programming method (24 Hour Non-Ramping, 24 Hour Ramping, Elapsed Non-Ramping, Elapsed Ramping)
- **Set Month** – This parameter sets the control system month
- **Set Day** – This parameter sets the control system day
- **Set Year** – This parameter sets the control system year
- **Set System Time** – This parameter sets the control system time
- **IP Address Mode** – This parameter sets the network connection method (Fixed, DHCP/Fixed)
- **Fixed IP Address** – This parameter defines the controller's fixed IP address
- **Fixed IP Subnet** – This parameter defines the controller's fixed IP subnet mask
- **Fixed IP Gateway** – This parameter defines the controller's fixed IP gateway address
- **Cloud Server IP** – This parameter defines the cloud server IP address for remote data logging
- **Cloud Security** – This parameter defines which cloud connection port the system utilizes for remote data logging
- **Cloud Default Port** – This parameter defines the default cloud connection port address

- **Cloud Secure Port** – This parameter defines the secure cloud connection port address
- **Cloud Customer ID** – This parameter is used to authenticate a controller with the remote data logging (cloud) software application
- **Cloud Connection** – This parameter enables/disables whether the controller uploads data to the remote (cloud) software application
- **Bluetooth Enable** – This parameter enables/disables the controller's Bluetooth antenna
- **WeatherEze Enable** – This parameter enables/disables the controller's ability to connect properly with the WeatherEze software application

To access the User Setup Menu, use the following steps:

- 1) Press the **ENTER** and **▲** keys simultaneously for approximately 2 seconds
- 2) Enter the 4-digit access pin at the Login Password screen. **Note:** The default password pin is '1111'.
- 3) Use the **▲** or **▼** keys to set the first character in the pin number.
- 4) Press the **PROGRAM** key to move the cursor to the next character in the password pin.
- 5) Repeat steps 3) and 4) until the passcode has been entered. **Note:** Pressing the **PROGRAM** key again on the last character in the pin will move the cursor back to the first character. This can be used to review the passcode has been entered correctly.
- 6) Press the **ENTER** key to submit the passcode.
- 7) If the correct code was entered, the display will show the top User Menu Setting of 'Change Lvl1 Password'. If the passcode was incorrectly entered, the default pin was changed by a different user, the will display a 'Login Failed' message. The user will be required to repeat the above process with the correct passcode to enter the User Setup Menu.

Use the following steps to modify settings within the User Setup Menu. Please refer to the appropriate user manual section for additional information on the parameter(s) to be modified within this menu.

- 1) Press the **ENTER** key and use the **▼** and **▲** keys as necessary to change the desired setting.
- 2) Press the **ENTER** key to accept the changes.

To exit the User Setup Menu:

- 1) Press the **ENTER** and **▲** keys simultaneously for approximately 2 seconds to return to the main display window, or
- 2) After 1 minute of inactivity, the controller will automatically return to the main display screen.

Configuring Security (optional)

IMPORTANT!

Please be aware of the following points before configuring security

- Security is optional. If not necessary, do not configure security on the IntellusUltra control system.
- If unsure about how to configure security, please contact Percival Scientific. If security configuration is not properly performed, it can result in the controller becoming password locked. If this happens the controller will need to be returned to Percival Scientific and unlocked at the user's expense.
- Always write down passwords as they are changed. This will prevent the inadvertent restriction of access to the controller.
- Keep the passwords in a safe place that is readily accessible only by those trusted with full access to the controller.

Four levels of security are available with the IntellusUltra controller. Levels one through three can be assigned a password up to four characters. When each IntellusUltra control system leaves Percival Scientific, security is disabled. To activate security, change only one of the default passwords. A description of what is accessible via each level is as follows:

Level 4

Level 4 is the most secure level and only allows access to the display loop. No password exists for this level. When logging off, or if the controller senses no keypad activity for five minutes, the controller will revert to this level if security has been enabled.

Level 3

Level 3 allows level 4 access plus access to the diagnostics menu and changing the temperature alarms (if activated), humidity alarms (if activated), auxiliary alarms (if activated) and any expansion channel alarms (if activated). When logging in to the controller, the Level 3 password must be entered to gain access to this level.

Level 2

Level 2 allows level 3 access, plus full access to the time menu, inputs menu, lights menu, data log menu and alarms menu. Level 2 also allows the running of program files, but restricts the ability to create/edit programs and sequences. When logging in to the controller, the Level 2 password must be entered to gain access to this level.

Level 1

Level 1 allows full access to the controller. When logging in to the controller, the Level 1 password must be entered to gain access to this level.

Security Level

The Security Level password is used to gain entry to the menu that allows the changing of passwords. The security password cannot be used to log in and out of the controller.

Use the following procedure to configure security:

- 1) Hold both the **ENTER** and **▲** keys simultaneously for approximately four seconds. The controller will prompt the user to enter the security level password, which by default is '1111'.
- 2) If the first character of the password is not flashing, press the **ENTER** key.
- 3) Use the **▼** and **▲** keys as necessary to change characters. Press the **PROGRAM** key to advance to the next character. You may repeatedly press the **PROGRAM** key to scroll through and review the password. Pressing the **PROGRAM** key at the last character will cause the character selection to wrap around. Press the **ENTER** key when the password '1111' has been successfully entered.
- 4) The user is prompted to change the Level 1 (Lvl1) password. The default password is '0001'. If you do not wish to change the password, press the **▼** key and skip to step 10).
- 5) To change the password, press **ENTER**.
- 6) Use the **▼** or **▲** key to change the flashing prompt to 'Yes' and then press **ENTER**.
- 7) Press the **▼** key. The user will be prompted to enter a new password for level 1. To enter the password, press **ENTER**.
- 8) The first character will begin flashing. Use the **▼** and **▲** keys as necessary to change characters. Press the **PROGRAM** key to advance to the next character. Repeatedly press the **PROGRAM** key to scroll through and review the password. Press the **ENTER** key when the password has been successfully changed.

- 9) Press the ▼ key to advance to the next password prompt.
- 10) The user will be prompted to change the Level 2 (Lvl2) password. The default password is '0002'. If you do not wish to change the password, press the ▼ key and skip to step 16).
- 11) To change the password, press **ENTER**.
- 12) Use the ▼ or ▲ key to change the flashing prompt to 'Yes' and then press **ENTER**.
- 13) Press the ▼ key. The user will be prompted to enter a new password for level 2. To enter the password, press **ENTER**.
- 14) The first character will begin flashing. Use the ▼ and ▲ keys as necessary to change characters. Press the **PROGRAM** key to advance to the next character. Repeatedly press the **PROGRAM** key to scroll through and review the password. Press the **ENTER** key when the password has been successfully changed.
- 15) Press the ▼ key to advance to the next password prompt.
- 16) The user will be prompted to change the Level 3 (Lvl3) password. The default password is '0003'. If you do not wish to change the password, press the ▼ key and skip to step 22).
- 17) To change the password, press **ENTER**.
- 18) Use the ▼ or ▲ key to change the flashing prompt to 'Yes' and then press **ENTER**.
- 19) Press the ▼ key. The user will be prompted to enter a new password for level 3. To enter the password, press **ENTER**.
- 20) The first character will begin flashing. Use the ▼ and ▲ keys as necessary to change characters. Press the **PROGRAM** key to advance to the next character. Repeatedly press the **PROGRAM** key to scroll through and review the password. Press the **ENTER** key when the password has been successfully changed.
- 21) Press the ▼ key to advance to the next password prompt.
- 22) The user will be prompted to change the Security Level (Slvl) password. The default password is '1111'. To change the password, press **ENTER**.
- 23) Use the ▲ or ▼ key to change the flashing prompt to 'Yes' and then press **ENTER**.
- 24) Press the ▼ key. The user will be prompted to enter a new password for the security level. To enter the password, press **ENTER**.
- 25) The first character will begin flashing. Use the ▼ and ▲ keys as necessary to change characters. Press the **PROGRAM** key to advance to the next character. You may repeatedly press the **PROGRAM** key to scroll through and review the password.
- 26) Press the **ENTER** key when the password has been successfully changed.

⚠ CAUTION

It is necessary to change the security level password when implementing security. The security level password is used to enter the menu that allows the changing of passwords. If this password is not changed, anyone could use the default '1111' password and override password settings. **NOTE:** It is *extremely important* that the security level password is remembered, after it has been changed. If forgotten, the controller will need to be returned to Percival Scientific at the user's expense, in order to restore it to its password defaults.

To exit the security menu, press and hold both the **ENTER** and **▲** keys simultaneously for approximately four seconds.

Logging In/Out

Once security is enabled, the following login procedure will be necessary each time the control system needs to be accessed:

- 1) Press and hold both the **ALARMS** and **▼** keys until prompted to enter your password.
- 2) Use the **▼** and **▲** keys as necessary to change characters. Press the **PROGRAM** key to advance to the next character. Repeatedly press the **PROGRAM** key to scroll through and review the password. Pressing the **PROGRAM** key at the last character will cause the character selection to wrap around.
- 3) Press the **ENTER** key when the password has been successfully entered.

To log out, use the following procedure:

- 1) Press and hold both the **ALARMS** and **▼** keys until the "Logged Out" message appears.

⚠ CAUTION

Remember to log out when finished using the controller. The controller will automatically log out if there is no keypad activity for five minutes.

Disabling Security

To disable security, each password must be reset to its default. See the 'Configuring Security' section for information on settings passwords.

- Level 1 Default Password : '0001'
- Level 2 Default Password : '0002'
- Level 3 Default Password : '0003'
- Security Level Default Password : '1111'

IP Address Setup (IntellusUltraConnect Only)

The IntellusUltraConnect controller contains a built-in web server which allows programming and monitoring of the controller using a computer's web browser. The controller must be connected to an Ethernet network in order to use the web server. To communicate with the web server, the controller will need to be assigned a unique IP address. This can either be done using the controller or by using the web server. Please refer to the separate manual entitled, "IntellusUltraConnect Web Server" for information on setting the IP address via the web server.

The web server IP information can be assigned using the IntellusUltra Connect controller by following the steps below:

- 1) On the IntellusUltraConnect controller, hold both the **ENTER** and **▲** keys simultaneously for approximately four seconds.
- 2) The controller will prompt the user to enter the security level password. The default password is '1111'. If the first character of the password is not flashing, press the **ENTER** key.
- 3) Use the **▲** and **▼** keys as necessary to change characters. Press the **PROGRAM** key to advance to the next character. You may repeatedly press the **PROGRAM** key to scroll through and review the password. Pressing the **PROGRAM** key at the last character will cause the character selection to wrap around.
- 4) Press the **ENTER** key when the password '1111' has been successfully entered.
- 5) Press the **▼** key repeatedly until "IP Address Mode" appears in the display.
- 6) Press the **ENTER** key.
- 7) Use the **▲** or **▼** keys as necessary to select the desired IP address mode, then press the **ENTER** key again. Refer to the section titled **IP Address Mode** below for more information.
- 8) Press and release the **▼** key.
- 9) The user will be prompted to enter the fixed IP address. A unique IP address must be entered into the controller if the selected IP Address Mode is

“Fixed”. It is highly recommended that a unique, fixed IP address be entered, even if the intended IP Address Mode is “DHCP/Fixed”. The fixed address will be used if a DHCP server cannot be found when the IP address mode is set to “DHCP/Fixed”.

- 10) To enter the fixed IP, press the **ENTER** key.
- 11) Use the ▲ or ▼ keys as necessary to change each character of the IP address. Press the **PROGRAM** key to advance to the next character. Repeatedly press the **PROGRAM** key to advance to the next character. Pressing the **PROGRAM** key while on the last character, will increment the active character field back to the first character.
- 12) Press the **ENTER** key when the IP address has been entered.
- 13) Press and release the ▼ key.
- 14) “Fixed IP Subnet” should appear in the display. This is the subnet mask entry for the controller. Press the **ENTER** key.
- 15) Use the ▲ or ▼ keys as necessary to change each character of the subnet mask. Press the **PROGRAM** key to advance to the next character. Repeatedly press the **PROGRAM** key to advance to the next character. Pressing the **PROGRAM** key while on the last character will increment the active character field back to the first character.
- 16) Press the **ENTER** key when the subnet mask has been entered.
- 17) Press and release the ▼ key.
- 18) “Fixed IP Gateway” should appear in the display. This is the default gateway entry for the controller. Press the **ENTER** key.
- 19) Use the ▲ or ▼ keys as necessary to change each character of the gateway address. Press the **PROGRAM** key to advance to the next character. Repeatedly press the **PROGRAM** key to advance to the next character. Pressing the **PROGRAM** key while on the last character will increment the active field back to the first character.
- 20) Press the **ENTER** key when the gateway address has been entered.
- 21) Hold both the **ENTER** and ▲ keys simultaneously for approximately four seconds to return to the main status menu.
- 22) Cycle power to the chamber (turn chamber power off then on again). The controller will begin to use the assigned network settings after restarting.

To verify that the controller is using the new IP settings, use the following procedure:

- 1) Press and release the **DIAGNOSTICS** key.
- 2) Press and release the ▼ key until “Active IP Address” appears in the display. This display will reflect the IP address that was either assigned automatically via DHCP or the fixed IP address that was manually entered. If the active IP address does not match what was entered, review the IP settings.

For basic troubleshooting:

- Inside the Diagnostics menu, the Network Status screen can be used to help troubleshoot network connection problems. A Network Status of 'Down' typically indicates a physical connection problem between the IntellusUltraConnect controller and the desired network. A good connection to the network will show a Network Status of the connection speed (i.e. 100Mbps)
- Use the PING command to test connectivity to the controller. For example, if the active IP address is "192.168.1.1" the proper syntax to test connectivity via the command prompt is "ping 192.168.1.1". If the controller does not respond, make sure the IP address is unique on the desired network.

IP Address Mode

The IP address mode can be set to either of the following:

- DHCP/Fixed
- Fixed

When the IP address mode is set to DHCP/Fixed, the controller will follow the standard rules to seek out and receive an IP address from a DHCP server. If the controller does not locate a DHCP server, it will fall back to using the Fixed IP address. When set to DHCP/Fixed mode, the controller will continue to periodically attempt to discover a DHCP server if one cannot be initially located. If a router is located between the controller and the DHCP server, make sure the router is capable of forwarding DHCP/BOOTP messages, or that a DHCP relay agent is in place.

When the IP address mode is set to Fixed, use the steps described above to manually assign a unique IP address, subnet mask and default gateway address in the controller.

It is recommended that the IP address mode be set to 'DHCP/Fixed' if a DHCP server is available. If a DHCP server is not available, it is recommended that the IP address mode is set to 'Fixed'.

If further assistance is necessary, contact Percival Scientific Customer support at:

- 1-800-695-2743
- 515-465-9363
- parts@percival-scientific.com
- <https://www.percival-scientific.com/contact-us/parts-services>

Web Server (IntellusUltraConnect Only)

The IntellusUltraConnect controller contains a built-in web server which can be used to remotely program and monitor the controller using a computer with a web browser. Please refer to the separate “IntellusUltra Web Server” manual for information on using the web server.

Changing Date

The date is factory-set by Percival Scientific. It is used in diagnostics for the last power up time. The IntellusUltraConnect controller also uses the date for the data logging processes.

If the date is incorrect, it can be changed by the following procedure:

- 1) Hold both the **ENTER** and **▲** keys simultaneously for approximately four seconds. The controller will prompt you to enter the security level password. The default password is ‘1111’. If the first character of the password is not flashing, press the **ENTER** key.
- 2) Use the **▲** and **▼** keys as necessary to change characters. Press the **PROGRAM** key to advance to the next character. Repeatedly press the **PROGRAM** key to scroll through and review the password. Pressing the **PROGRAM** key at the last character will cause the character selection to wrap around.
- 3) Press the **ENTER** key when the password ‘1111’ has been successfully entered.
- 4) Press the **▼** key repeatedly until “Set Month” appears in the display. If this setting does not need to be changed, skip to step 7).
- 5) Press the **ENTER** key.
- 6) Use the **▲** or **▼** keys as necessary to select the desired month, then press the **ENTER** key to accept the new value.
- 7) Press and release the **▼** key until prompted to “Set Day”. If this setting does not need to be changed, skip to step 10).
- 8) Press the **ENTER** key.
- 9) Use the **▲** or **▼** keys as necessary to select the desired day, then press the **ENTER** key to accept the new value.
- 10) Press and release the **▼** key until prompted to “Set Year”. If this setting does not need to be changed, skip to step 13).
- 11) Press the **ENTER** key.
- 12) Use the **▲** or **▼** keys as necessary to select the desired year, then press the **ENTER** key.
- 13) Hold both the **ENTER** and **▲** keys simultaneously for approximately four seconds to return to the main status menu.

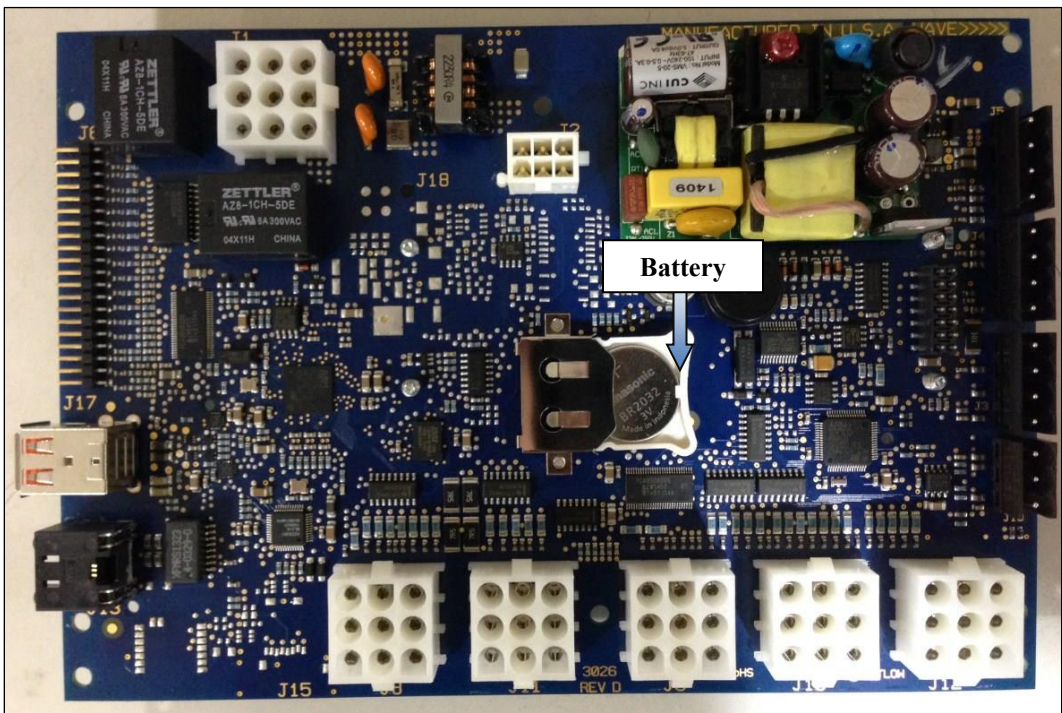
Battery Backup

A battery is provided to protect the volatile memory of the controller in the cases where power is not applied to the chamber. Certain controller parameters are stored in the volatile memory such as controller time and running program status.

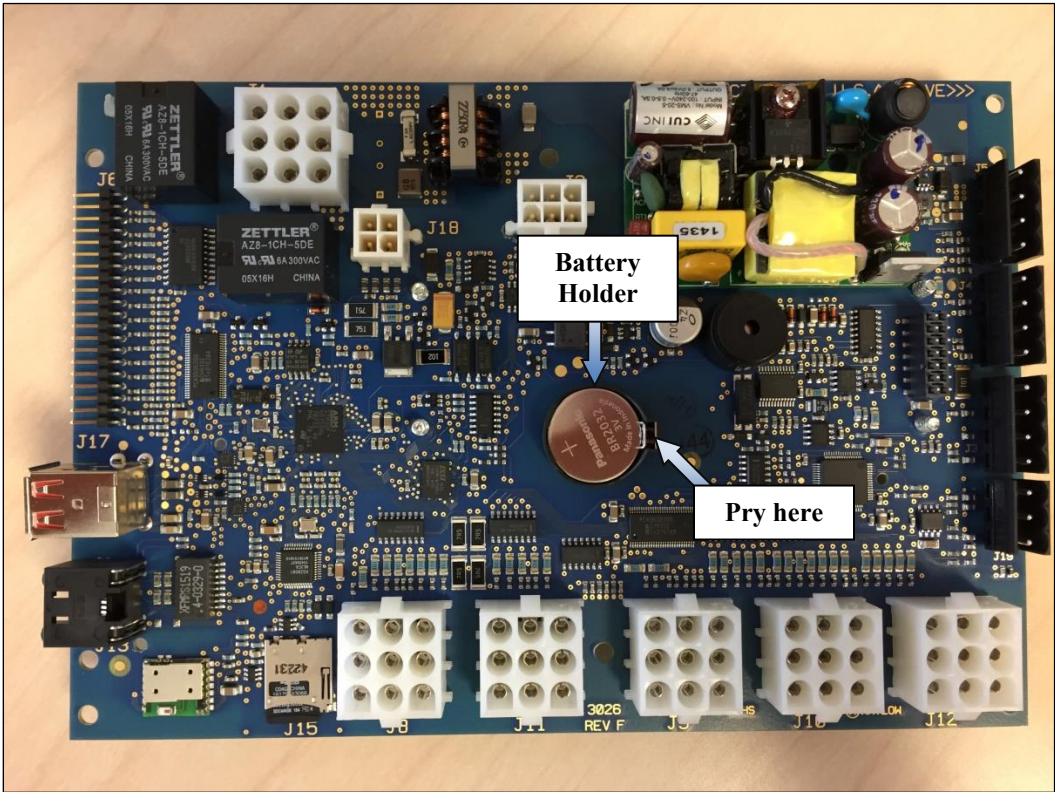
The approximate life expectancy of the battery is 7 years. It is recommended that the battery be replaced every 5 years to prevent the controller from losing its volatile memory contents when power is not applied.

The battery can be replaced by the end user. A 3V lithium battery similar to a watch battery is used. The direct replacement number is Panasonic BR2032, but a suitable equivalent may be used. To replace the battery, use the following procedure:

- 1) Turn power to the chamber off and unplug all chamber power cords.
- 2) Access the rear of the IntellusUltra controller inside of its control enclosure.
- 3) Use a small flat head screwdriver to carefully pry the battery from its holder. Be sure not to touch any of the other board components with the screwdriver when prying the battery loose. **Do not use a magnetized screwdriver!**
- 4) Replace the battery.
- 5) Re-apply power to the chamber.
- 6) Set the controller time and manual settings as necessary. If a program was in operation, it will need to be restarted as the controller reverts to Manual Mode after the battery is replaced.
- 7) There are two types of battery holder hardware on the IntellusUltra controller – please refer to the pictures below.
- 8) If assistance is necessary, please contact Percival Scientific.



IntellusUltra battery slot and holder (hardware REV F through REV G)



Plant Growth Tables (Propogation)

PLANT Common name	PLANT Scientific name	Propagation PPF	Propagation Photoperiod (Hrs/day)	Propagation DLI (mol/m ² /day)	Propagation Temp °C (light)	Propagation Temp °C (dark)
African Violet	Saintpaulia ionantha	150	12	6.48	23	23
Agerantum	Agerantum houstonianum	450	20	32.4	25	20
Alfalfa	Medicago sativa	450	20	32.4	25	20
Peruvian Lily	Alstroemeria	450	12	19.44	25	20
Annual Bluegrass	Poa annua	450	20	32.4	23	23
Arabidopsis	Arabidopsis thaliana	250	8	7.2	24	24
Azalea	Rhododendron	250	14	12.6	25	23
Barley	Hodeum vulgare	450	12	19.44	23	18
Bean	Phaseolus vulgaris L	450	20	32.4	22	22
Blueberry, Rabbit-eye	Vaccinium ashe/Reade	700	20	50.4	25	20
Cabbage	Brassica oleraceae var.L	450	20	32.4	25	25
Cactus,Thanksgiving	Schlumbergera truncata(Haw.) Moran	450	14	22.68	23	23
Calceolaria (Pocketbook Plant)	Calceolaria herbeohybrida Voss.	700	12	30.24	20	20
Carnation	Dianthus caryophyllus L	700	12	30.24	20	15
Chrysanthemum	Dendranthema grandiflorum (Ramato) Kitam	700	16	40.32	23	23
Cineraria	Senecio cruentus (Masson ex.L'Her.)D.C.	450	12	19.44	20	20
Citrus	Citrus spp.	450	20	32.4	28	23
Cocklebur	Xanthium strumarium L.	450	16	25.92	25	25
Corn	Zea mays L.	450	14	22.68	28	23
Cosmos	Cosmos bipinnatus Cav.	450	16	25.92	23	23
Cotton	Gossypium hirsutum L.	450	20	32.4	28	28

PLANT Common name	PLANT Scientific name	Propagation PPF	Propagation Photoperiod (Hrs/day)	Propagation DLI (mol/m ² /day)	Propagation Temp °C (light)	Propagation Temp °C (dark)
Cucumber	Gossypium hirsutum L.	450	20	32.4	25	25
Cyclamen	Cyclamen pesicum Mill.	0	0	0	16	16
Fuchsia	Fuchsia X hybrida Hort. Ex Vilm.	250	12	10.8	23	23
Geranium	Pelargonium spp.	450	20	32.4	25	20
Gerbera (Transvaal Daisy)	Gerbera jamesonli Bolus es Hook f.	250	12	10.8	25	20
Gloxinia	Sinningia speciosa (Lodd.) Hiem	250	12	10.8	20	20
Grape	Vitus spp.	700	20	50.4	25	20
Henbane	Hyocymus niger L.	450	8	12.96	25	25
Hydrangea	Hydrangea macrophylla (Thunb.) Ser.	450	14	22.68	23	23
Kalanchoe	Kalanchoe blossfeldiana Poelin.	450	14	22.68	23	23
Lambsquarters	Chenopodium album L.	450	14	22.68	25	20
Lettuce	Lactuca sativa L.	450	20	32.4	25	20
Liatris (Gayfeather)	Liatris spp.	250	12	10.8	23	23
Marigold	Tagetes erecta L.	450	20	32.4	25	20
Oats	Avena sativa L.	450	20	32.4	25	20
Pea	Pisum sativum L.	450	20	32.4	23	23
Peanut	Arachis hypogaea L.	0	0	0	25	25
Pepper	Capsicum annum(L.) var.annuum	450	20	32.4	25	20
Perilla	Perilla frutescens (L.) Britt	450	16	25.92	25	25
Petunia	Petunia x hybrida Vilm.	450	20	32.4	25	20
Pharbitis	Pharbitis Nil (L.) Roth	250	16	14.4	25	25

PLANT Common name	PLANT Scientific name	Propagation PPF	Propagation Photoperiod (Hrs/day)	Propagation DLI (mol/m ² /day)	Propagation Temp °C (light)	Propagation Temp °C (dark)
Pigweed	Amaranthus spp.	450	16	25.92	25	20
Poinsettia	Euphorbia pulcherrima Willd.ex Klotzch	250	14	12.6	25	20
Potato, Sweet	Ipomea batatas (L.) Lam.	450	20	32.4	25	25
Potato, White	Solanum tuberosum L.	450	20	32.4	23	18
Rice	Oryza sativa L.	450	20	32.4	30	20
Rose	Rosa mult. Flora Thunb.	250	12	10.8	23	23
Ryegrass	Lolium multiflorum Lam.	450	20	32.4	23	18
Salvia	Salvia splendens Sellow ex Schultes	450	24	38.88	23	23
Scrophularia	Scrophularia marilandica L.	250	8	7.2	20	13
Silene	Silene armeria L.	0	0	0	25	25
Sinapsis	Sinapsis alba L.	450	20	32.4	25	25
Snapdragon	Antirrhinum majus L.	450	12	19.44	23	23
Soybean	Glycine max (L.) Merr	450	12	19.44	28	23
Spinach	Spinacia oleracea L.	450	12	19.44	20	20
Strawberry	Fragaria x ananassa Duch.	450	20	32.4	18	18
Tobacco	Nicotiana tabacum L.	450	20	32.4	25	20
Tomato	Lycopersicon esculentum	450	20	32.4	25	20
Wheat	Triticum aestivum L.	450	20	32.4	25	20

Plant Growth Tables (Vegetative)

PLANT Common name	PLANT Scientific name	Vegetative PPF	Vegetative Photoperiod (Hrs/day)	Vegetative DLI (mol/m ² /day)	Vegetative Temp °C (light)	Vegetative Temp °C (dark)
African Violet	Saintpaulia ionantha	250	12	10.8	23	23
Agerantum	Agerantum houstonianum	450	20	32.4	25	20
Alfalfa	Medicago sativa	450	20	32.4	22	22
Peruvian Lily	Alstroemeria	450	12	19.44	20	20
Annual Bluegrass	Poa annua	450	20	32.4	20	20
Apple	Malus domestica	700	20	50.4	25	20
Arabidopsis	Arabidopsis thaliana	250	8	7.2	20	20
Avocado	Persea americana	450	20	32.4	25	20
Azalea	Rhododendron	450	14	22.68	25	20
Barley	Hodeum vulgare	450	12	19.44	23	18
Bean	Phaseolus vulgaris L	450	20	32.4	22	22
Blueberry, Highbush	Vaccinium corymbosum L	700	14	35.28	25	20
Blueberry, Rabbit-eye	Vaccinium ashe/Reade	700	14	35.28	25	20
Bramble	Rubus spp.	450	20	32.4	25	20
Cabbage	Brassica oleraceae var.L	450	14	22.68	20	15
Cactus, Thanksgiving	Schlumbergera truncata(Haw.) Moran	450	14	22.68	25	18
Calceolaria (Pocketbook Plant)	Calceolaria herbeohybrida Voss.	450	18	29.16	20	15
Carnation	Dianthus caryophyllus L	450	12	19.44	20	15
Cherry	Prunus spp.	700	20	50.4	25	20
Chrysanthemum	Dendranthema grandiflorum (Ramato) Kitam	450	16	25.92	25	18
Cineraria	Senecio cruentus (Masson ex.L'Her.)D.C.	450	12	19.44	20	20
Citrus	Citrus spp.	700	20	50.4	28	23

PLANT Common name	PLANT Scientific name	Vegetative PPF	Vegetative Photoperiod (Hrs/day)	Vegetative DLI (mol/m ² /day)	Vegetative Temp °C (light)	Vegetative Temp °C (dark)
Cocklebur	Xanthium strumarium L.	450	20	32.4	25	20
Corn	Zea mays L.	700	20	50.4	28	23
Cosmos	Cosmos bipinnatus Cav.	450	16	25.92	25	20
Cotton	Gossypium hirsutum L.	450	20	32.4	28	28
Cucumber	Gossypium hirsutum L.	450	16	25.92	25	25
Cyclamen	Cyclamen pesicum Mill.	450	12	19.44	20	20
Easter Lily	Lilium longiflorum Thunb. Var.eximium Baker	450	12	19.44	20	20
Fuchsia	Fuchsia X hybrida Hort. Ex Vilm.	450	12	19.44	20	20
Geranium	Pelargonium spp.	450	20	32.4	25	20
Gerbera (Transvaal Daisy)	Gerbera jamesonli Bolus es Hook f.	450	12	19.44	25	18
Gloxinia	Sinningia speciosa (Lodd.) Hiem	450	12	19.44	25	20
Grape	Vitus spp.	700	20	50.4	25	20
Henbane	Hyocyanus niger L.	450	8	12.96	23	23
Hydrangea	Hydrangea macrophylla (Thunb.) Ser.	450	14	22.68	25	18
Kalanchoe	Kalanchoe blossfeldiana Poelin.	450	14	22.68	23	20
Lambsquarters	Chenopodium album L.	450	14	22.68	25	20
Lettuce	Lactuca sativa L.	450	20	32.4	25	20
Liatris (Gayfeather)	Liatris spp.	450	12	19.44	25	15
Marigold	Tagetes erecta L.	450	20	32.4	25	20
Oats	Avena sativa L.	450	20	32.4	25	20

PLANT Common name	PLANT Scientific name	Vegetative PPF	Vegetative Photoperiod (Hrs/day)	Vegetative DLI (mol/m ² /day)	Vegetative Temp °C (light)	Vegetative Temp °C (dark)
Olive	Olea europaea L.	700	14	35.28	23	18
Pea	Pisum sativum L.	450	20	32.4	23	23
Peach	Prunus persica (L.) Batsch	700	20	50.4	25	20
Peanut	Arachis hypogaea L.	450	20	32.4	25	25
Pear	Pyrus communis L.	700	20	50.4	25	20
Pepper	Capsicum annuum(L.) var.annuum	450	20	32.4	25	20
Perilla	Perilla frutescens (L.) Britt	450	16	25.92	20	20
Petunia	Petunia x hybrida Vilm.	450	20	32.4	25	20
Pharbitis	Pharbitis Nil (L.) Roth	450	16	25.92	25	25
Pigweed	Amaranthus spp.	450	16	25.92	25	20
Poinsettia	Euphorbia pulcherrima Willd.ex Klotzch	450	14	22.68	25	20
Potato, Sweet	Ipomea batatas (L.) Lam.	250	14	12.6	25	25
Potato, White	Solanum tuberosum L.	450	20	32.4	23	18
Rice	Oryza sativa L.	450	20	32.4	30	20
Rose	Rosa mult. Flora Thunb.	450	12	19.44	23	18
Ryegrass	Lolium mulitflorum Lam.	450	20	32.4	20	15
Salvia	Salvia splendens Sellow ex Schultes	450	12	19.44	25	20
Scrophularia	Scrophularia marilandica L.	450	8	12.96	20	20
Silene	Silene armeria L.	450	8	12.96	20	20
Sinapsis	Sinapsis alba L.	450	20	32.4	20	20
Snapdragon	Antirrhinum majus L.	450	12	19.44	25	15

PLANT Common name	PLANT Scientific name	Vegetative PPF	Vegetative Photoperiod (Hrs/day)	Vegetative DLI (mol/m ² /day)	Vegetative Temp °C (light)	Vegetative Temp °C (dark)
Soybean	Glycine max (L.) Merr	450	20	32.4	28	23
Spinach	Spinacia oleracea L.	450	12	19.44	20	20
Strawberry	Fragaria x ananassa Duch.	450	20	32.4	20	15
Tobacco	Nicotiana tabacum L.	450	20	32.4	25	20
Tomato	Lycopersicon esculentum	700	20	50.4	25	20
Wheat	Triticum aestivum L.	450	20	32.4	20	15

Plant Growth Tables (Flower Initiation/Dev)

PLANT Common name	PLANT Scientific name	Flower Initiation /Dev (PPF)	Flower Initiation /Dev Photoperiod (Hrs/day)	Flower Initiation /Dev DLI (mol/m ² /day)	Flower Initiation /Dev Temp °C (light)	Flower Initiation /Dev Temp °C (dark)
African Violet	Saintpaulia ionantha	250	12	10.8	23	23
Agerantum	Agerantum houstonianum	450	20	32.4	25	20
Alfalfa	Medicago sativa	450	16	25.92	25	25
Peruvian Lily	Alstroemeria	450	12	19.44	20	15
Annual Bluegrass	Poa annua	450	20	32.4	20	20
Apple	Malus domestica	700	20	50.4	25	20
Arabidopsis	Arabidopsis thaliana	250	16	14.4	20	20
Avocado	Persea americana	450	20	32.4	20	15
Azalea	Rhododendron	450	10	16.2	25	25
Barley	Hodeum vulgare	450	20	32.4	23	18
Bean	Phaseolus vulgaris L	450	20	32.4	22	18
Blueberry, Highbush	Vaccinium corymbosum L	700	20	50.4	20	15
Blueberry, Rabbit-eye	Vaccinium ashe/Reade	700	20	50.4	12	20
Bramble	Rubus spp.	450	20	32.4	25	20

PLANT Common name	PLANT Scientific name	Flower Initiation /Dev (PPF)	Flower Initiation /Dev Photoperiod (Hrs/day)	Flower Initiation /Dev DLI (mol/m ² /day)	Flower Initiation /Dev Temp °C (light)	Flower Initiation /Dev Temp °C (dark)
Cabbage	Brassica oleraceae var.L	700	14	35.28	8	8
Cactus,Thanksgiving	Schlumbergera truncata(Haw.) Moran	450	12	19.44	20	18
Calceolaria (Pocketbook Plant)	Calceolaria herbeohybrida Voss.	450	18	29.16	20	15
Carnation	Dianthus caryophyllus L	450	12	19.44	18	13
Cherry	Prunus spp.	700	20	50.4	25	20
Chrysanthemum	Dendranthema grandiflorum (Ramato) Kitam	450	10	16.2	25	15
Cineraria	Senecio cruentus (Masson ex.L'Her.)D.C.	450	12	19.44	20	13
Citrus	Citrus spp.	700	20	50.4	28	23
Cocklebur	Xanthium strumarium L.	450	8	12.96	25	20
Corn	Zea mays L.	700	14	35.28	28	23
Cosmos	Cosmos bipinnatus Cav.	450	8	12.96	25	20
Cotton	Gossypium hirsutum L.	450	12	19.44	30	25
Cucumber	Gossypium hirsutum L.	450	20	32.4	25	25
Cyclamen	Cyclamen pesicum Mill.	450	12	19.44	20	20
Easter Lily	Lilium longiflorum Thunb. Var.eximium Baker	450	12	19.44	20	20
Fuchsia	Fuchsia X hybrida Hort. Ex Vilm.	450	16	25.92	20	20
Geranium	Pelargonium spp.	450	20	32.4	25	20
Gerbera (Transvaal Daisy)	Gerbera jamesonli Bolus es Hook f.	450	12	19.44	25	18

PLANT Common name	PLANT Scientific name	Flower Initiation /Dev (PPF)	Flower Initiation /Dev Photoperiod (Hrs/day)	Flower Initiation /Dev DLI (mol/m ² /day)	Flower Initiation /Dev Temp °C (light)	Flower Initiation /Dev Temp °C (dark)
Gloxinia	Sinningia speciosa (Lodd.) Hiem	450	12	19.44	25	20
Grape	Vitus spp.	700	20	50.4	25	20
Henbane	Hyocymus niger L.	450	16	25.92	23	20
Hydrangea	Hydrangea macrophylla (Thunb.) Ser.	450	14	22.68	25	15
Kalanchoe	Kalanchoe blossfeldiana Poelin.	450	10	16.2	23	120
Lambsquarters	Chenopodium album L.	450	12	19.44	25	20
Lettuce	Lactuca sativa L.	450	20	32.4	25	20
Liatris (Gayfeather)	Liatris spp.	450	12	19.44	25	15
Marigold	Tagetes erecta L.	450	20	32.4	25	20
Oats	Avena sativa L.	450	24	38.88	25	20
Olive	Olea europaea L.	700	20	50.4	12	12
Pea	Pisum sativum L.	450	20	32.4	20	15
Peach	Prunus persica (L.) Batsch	700	20	50.4	25	20
Peanut	Arachis hypogaea L.	450	20	32.4	30	23
Pear	Pyrus communis L.	700	20	50.4	25	20
Pepper	Capsicum annuum(L.) var.annuum	450	20	32.4	25	20
Perilla	Perilla frutescens (L.) Britt	450	8	12.96	20	20
Petunia	Petunia x hybrida Vilm.	450	20	32.4	25	20
Pharbitis	Pharbitis Nil (L.) Roth	450	8	12.96	30	30
Pigweed	Amaranthus spp.	450	8	12.96	25	20

PLANT Common name	PLANT Scientific name	Flower Initiation /Dev (PPF)	Flower Initiation /Dev Photoperiod (Hrs/day)	Flower Initiation /Dev DLI (mol/m ² /day)	Flower Initiation /Dev Temp °C (light)	Flower Initiation /Dev Temp °C (dark)
Poinsettia	Euphorbia pulcherrima Willd.ex Klotzch	450	10	16.2	25	18
Potato, Sweet	Ipomea batatas (L.) Lam.	450	14	22.68	25	25
Potato, White	Solanum tuberosum L.	450	20	32.4	23	18
Rice	Oryza sativa L.	450	20	32.4	30	20
Rose	Rosa mult. Flora Thunb.	450	12	19.44	23	18
Ryegrass	Lolium multiflorum Lam.	450	16	25.92	23	18
Salvia	Salvia splendens Sellow ex Schultes	450	12	19.44	25	20
Scrophularia	Scrophularia marilandica L.	450	16	25.92	20	20
Silene	Silene armeria L.	450	16	25.92	20	20
Sinapsis	Sinapsis alba L.	450	8	12.96	20	20
Snapdragon	Antirrhinum majus L.	450	12	19.44	20	13
Soybean	Glycine max (L.) Merr	450	20	32.4	28	23
Spinach	Spinacia oleracea L.	450	15	24.3	25	25
Strawberry	Fragaria x ananassa Duch.	450	12	19.44	20	15
Tobacco	Nicotiana tabacum L.	450	20	32.4	25	20
Tomato	Lycopersicon esculentum	700	20	50.4	25	20
Wheat	Triticum aestivum L.	450	20	32.4	23	18

Plant Growth Tables (Fruit/Seed Dev.)

PLANT Common name	PLANT Scientific name	Fruit/Seed Dev. PPF	Fruit/Seed Dev. Photoperiod (Hrs/day)	Fruit/Seed Dev. DLI (mol/m ² /day)	Fruit/Seed Dev. Temp °C (light)	Fruit/Seed Dev. Temp °C (dark)
Alfalfa	Medicago sativa	450	16	25.92	25	25
Annual Bluegrass	Poa annua	450	20	32.4		
Apple	Malus domestica	700	20	50.4	25	20
Arabidopsis	Arabidopsis thaliana	250	16	14.4	20	20
Avocado	Persea americana	450	20	32.4	25	20
Barley	Hodeum vulgare	450	20	32.4	23	18
Bean	Phaseolus vulgaris L	450	20	32.4	25	20
Blueberry, Highbush	Vaccinium corymbosum L	700	20	50.4	20	13
Blueberry, Rabbit-eye	Vaccinium ashe/Reade	700	20	50.4	25	20
Bramble	Rubus spp.	450	12	19.44	25	20
Cabbage	Brassica oleraceae var.L	450	20	32.4	20	15
Cherry	Prunus spp.	700	20	50.4	25	20
Citrus	Citrus spp.	700	20	50.4	28	23
Cocklebur	Xanthium strumarium L.	450	8	12.96	25	20
Corn	Zea mays L.	700	14	35.28	28	23
Cotton	Gossypium hirsutum L.	450	20	32.4	30	25
Cucumber	Gossypium hirsutum L.	450	20	32.4	25	25
Grape	Vitus spp.	450	20	32.4	25	20
Lambsquarters	Chenopodium album L.	450	12	19.44	25	20
Lettuce	Lactuca sativa L.	450	20	32.4	25	20
Oats	Avena sativa L.	450	20	32.4		
Olive	Olea europaea L.	700	20	50.4	23	18
Pea	Pisum sativum L.	450	20	32.4	23	18
Peach	Prunus persica (L.) Batsch	700	20	50.4	25	20
Peanut	Arachis hypogaea L.	450	20	32.4	30	23

PLANT Common name	PLANT Scientific name	Fruit/Seed Dev. PPF	Fruit/Seed Dev. Photoperiod (Hrs/day)	Fruit/Seed Dev. DLI (mol/m ² /day)	Fruit/Seed Dev. Temp °C (light)	Fruit/Seed Dev. Temp °C (dark)
Pear	Pyrus communis L.	700	20	50.4	25	20
Pepper	Capsicum annuum(L.) var.annuum	450	20	32.4	25	20
Perilla	Perilla frutescens (L.) Britt	450	8	12.96	20	20
Potato, Sweet	Ipomea batatas (L.) Lam.	450	14	22.68	25	
Potato, White	Solanum tuberosum L.	450	20	32.4	23	18
Rice	Oryza sativa L.	450	12	19.44	30	20
Soybean	Glycine max (L.) Merr	450	12	19.44	28	23
Spinach	Spinacia oleracea L.	450	15	24.3	25	25
Strawberry	Fragaria x ananassa Duch.	450	20	32.4	20	15
Tobacco	Nicotiana tabacum L.	450	20	32.4	25	20
Tomato	Lycopersicon esculentum	700	20	50.4	25	20
Wheat	Triticum aestivum L.	700	20	50.4	23	18

Program Entry Table

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User Notes / Password Log: