

INSTALLATION, OPERATION & SERVICE MANUAL

DESTINATION: India
MODEL: CU-41L5
SO#: 036171
S/N: 36171.01

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:

- SciWhite® and PetriClear™ LED tiles *
- Open loop dimmable lighting *
- Door lock *

* - 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.



CU-Series Chamber

Operator's Manual

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

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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

Version	Date	Description
V0	6/20/2025	Initial draft started
Rev A	7/15/2025	Document approved for distribution

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

General

Tissue culture controlled environmental chambers are specialized units designed to provide precise regulation of environmental parameters such as temperature, humidity, light intensity, and atmospheric gas composition. These chambers are essential tools in biological and agricultural research, offering a stable and reproducible environment for the cultivation of plant and animal tissues under sterile and carefully monitored conditions.

Commonly used in a wide range of scientific applications, these chambers support research in plant biotechnology, genetic engineering, cell biology, and pharmacology. They facilitate the study of plant growth and development, the production of genetically modified organisms, and the propagation of disease-free plant material. In biomedical fields, they are instrumental in maintaining mammalian cell cultures for vaccine development, drug screening, and regenerative medicine research.

These chambers are highly valued in academic, government, and commercial research laboratories where environmental accuracy and consistency are critical for experimental repeatability. These precision-controlled environments designed for tissue culture research enable reproducible growth conditions and are suitable for both short- and long-term studies.

This manual is intended to provide instructions on the installation, operation, maintenance and troubleshooting of Percival Scientific’s CU-22, 36, and 41Series base chamber models. The CU-30 is described in its own separate and specific operation manuals.

Users should read this manual thoroughly to ensure proper setup, calibration, programming, and maintenance to avoid damage to specimens or equipment and to ensure data integrity.

Equipment Overview:

CU-22L2



CU-36 Series (CU-36L5 pictured)



CU-41 Series (CU-41L5 pictured)

Product Specifications

CU-22L2 Specification Table

Model			CU-22L2
Temperature Range	Lights Off	Low	2.0°C
		High	44.0°C
		Range	±0.5°C
	Lights On	Low	10.0°C
		High	44.0°C
		Range	±0.5°C
Exterior Dimensions		Width	33.5 in (85.1 cm)
		Depth	36.6 in (93.0 cm)
		Height	77.9 in (197.9 cm)
Interior Volume per Compartment		ft ³	14.6
		m ³	0.4
		L	413.4
Number of Tiers per Compartment			2
Shelves per Tier			1
Shelf Dimensions		Width	28.8 in (73.0 cm)
		Depth	27.0 in (68.6 cm)
Total Shelf Area per Compartment		ft ² (m ²)	10.8 (1.0)
Growing Height per Tier		in (cm)	7.5 (19.1)
Door Opening		Width	29.3 in (74.3 cm)
		Height	27.8 in (70.6 cm)
Light Intensity @ 6" (μmol/m ² /s)			170
Electrical per Compartment		VAC	120V
		Phase	1
		Frequency	60Hz
		Cords (NEMA)	1 (5-15P)
		RLA per cord	9.9A
		MCA	12.4A
Heat Rejection to Ambient		Btu/h (W)	1990 (583)
Shipping Weight		lb (kg)	765 (347)

CU-36 Series Specification Table

Model			CU-36L4		CU-36L5	
Temperature Range	Lights Off	Low	2.0°C			
		High	44.0°C			
		Range	±0.5°C			
	Lights On	Low	10.0°C			
		High	44.0°C			
		Range	±0.5°C			
Exterior Dimensions		Width	33.5 in (85.1 cm)			
		Depth	33.6 in (85.4 cm)			
		Height	77.2 in (196.1 cm)			
Interior Volume		ft ³	29.7			
		m ³	0.8			
		L	840.4			
Number of Tiers			4		5	
Shelves per Tier			1			
Shelf Dimensions		Width	28.8 in (73.0 cm)			
		Depth	27.0 in (68.6 cm)			
Total Shelf Area		ft ² (m ²)	21.6 (2.0)		27.0 (2.5)	
Growing Height		in (cm)	9.3 (23.5)		6.7 (17.0)	
Door Opening		Width	29.3 in (74.3 cm)			
		Height	57.5 in (146.1 cm)			
Light Intensity @ 6" (μmol/m ² /s)			170			
Electrical		VAC	120V			
		Phase	1			
		Frequency	60Hz			
		Cords (NEMA)	2 (5-15P)			
		Cord 1 RLA	5.3A		5.7A	
		Cord 2 RLA	5.5A		6.4A	
		MCA	13.5A		15.1A	
Heat Rejection to Ambient		Btu/h (W)	2,750 (806)		2,999 (879)	
Shipping Weight		lb (kg)	626 (284)		673 (305)	

CU-41 Series Specification Table

Model			CU-41L4	CU-41L5
Temperature Range	Lights Off	Low	2.0°C	
		High	44.0°C	
		Range	±0.5°C	
	Lights On	Low	10.0°C	
		High	44.0°C	
		Range	±0.5°C	
Exterior Dimensions		Width	41.0 in (104.1 cm)	
		Depth	33.6 in (85.4 cm)	
		Height	77.2 in (196.1 cm)	
Interior Volume		ft ³	37.3	
		m ³	1.06	
		L	1055.1	
Number of Tiers			4	5
Shelves per Tier			1	
Shelf Dimensions		Width	36.3 in (92.2 cm)	
		Depth	27.0 in (68.6 cm)	
Total Shelf Area		ft ² (m ²)	27.2 (2.5)	34.0 (3.2)
Growing Height		in (cm)	9.5 (24.1)	6.7 (17)
Door Opening		Width	36.8 in (93.5 cm)	
		Height	57.5 in (146.1 cm)	
Light Intensity @ 6" (μmol/m ² /s)			200	
Electrical		VAC	120V	
		Phase	1	
		Frequency	60Hz	
		Cords (NEMA)	2 (5-15P)	
		Cord 1 RLA	7.1A	7.9A
		Cord 2 RLA	9.8A	9.8A
		MCA	21.1A	22.1A
Heat Rejection to Ambient		Btu/h (W)	3445 (1010)	3924 (1150)
Shipping Weight		lb (kg)	712 (323)	750 (340)

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 CU-22, CU-36, and CU-41 Series chambers are top heavy. Please use caution when removing a chamber 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.

Generally, space should be planned for door swings, removal of service panels, condensing unit intake and exhaust ventilation and shutoff valves for chamber services.

Provide at least six inches of clearance on the side and top of the CU-36 and CU-41 Series units to facilitate proper air flow through the condensing unit's heat exchanger. Air is drawn in through the right-handed side vent and exhausted through the top vent.

The CU-22L2 houses two condensing units (one for each environment) in its mechanical section. Air is drawn into the mechanical section on both the right and left sides of the unit. All air drawn into the condensing units' condensers is rejected out of vents located

on the back of the unit. A minimum of six inches clearance is required on the sides and back of the unit to facilitate proper air flow through the chambers' refrigeration systems.

Ambient Conditions

Published chamber performance specifications are based on the following ambient environmental conditions. To ensure best performance of an CU-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 estimated maximum-heat-rejection-to-ambient for the CU-Series chamber models 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

CU-Series controlled environment chambers are 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 CU-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, optional equipment, and characteristics of products placed inside the environment.

Optional relative humidity control systems increase the amount of condensate rejected from a given unit, and increasing the potential for condensation to form on petri dish lids.

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 CU-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.
- Replace the existing chamber drain fitting and tubing with a Q19 (External Drip Pan) optional equipment package.
- Route existing chamber drain tubing to a Q19 (External Drip Pan) when no space is available directly below the chamber drain
- Connect the existing chamber drain system to a condensate pump



Please note that the standard drain system in CU-Series controlled environment chambers works via gravity. Condensate only drains 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 action 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! All CU-Series chambers are heavy. The CU-22, CU-36, and CU-41 models are top-heavy. Please use caution when removing a chamber from its shipping container and while moving it into position. This task 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 its skid
4. Remove any bolts that affix the chamber to its skid
5. Remove the outer support boards on the sides of the chamber, allowing for more room to move the unit upon the skid
 - a. Remove wood screws
 - b. Slightly tip the unit to each side and pull the boards out from under the chamber
6. Manipulate the chamber toward the back of the shipping skid
7. Carefully allow the chamber to roll off the shipping skid backward, providing adequate support behind the unit to prevent it from tipping over. The rear casters, located at the back of the unit should come off the skid first.
8. Once the rear casters are in contact with the ground with the chamber in its tipped position, slide the skid out from under chamber.
9. After removal of the skid, carefully allow the chamber to tip forward, allowing all four casters to rest on the floor.

Moving the Chamber



Warning! All CU-Series chambers are heavy. The CU-22, CU-36, and CU-41 models are top heavy. Please use caution while moving any chamber. This task should be undertaken with care by more than one person.



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

The CU-22, CU-36, and CU-41 growth chambers are provided with swivel casters for the specific purposes of rolling empty units into their installation location, and moving units as needed for service and maintenance efforts.



The caster system is designed for moving empty chambers over short distances. Special care is needed when moving a unit over uneven floor surfaces.

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

Locate CU-Series chambers upon a level surface to facilitate proper function and drainage.

Adjustable levelers are provided with each base model CU-22, CU-36, and CU-41 chamber as a means of levelling the chamber for experiments and preventing chambers from rolling unexpectedly when in use.

Use a crescent wrench to adjust the vertical position of each leveler as necessary. A clockwise turn extends the leveler toward the floor and a counterclockwise turn retracts the leveler.



Levelers are designed to support the entire weight of a chamber, so can be adjusted to lift the unit off its casters to prevent inadvertent movement, if desired.

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 Shelving and Lights

All CU-Series controlled environment chambers are provided with steel wire shelving, lamp banks, and airflow plenums. Plenums and lamp banks are pre-installed at Percival's factory and shipped fully assembled. Shelving is shipped uninstalled and packaged within each chamber. To install shelving in a CU-Series base model chamber, and prepare the unit for use:

1. Remove cardboard shipping shims placed around light fixtures
2. Remove shelving from its packaging
3. Insert each shelf into its shelf support bracket slot

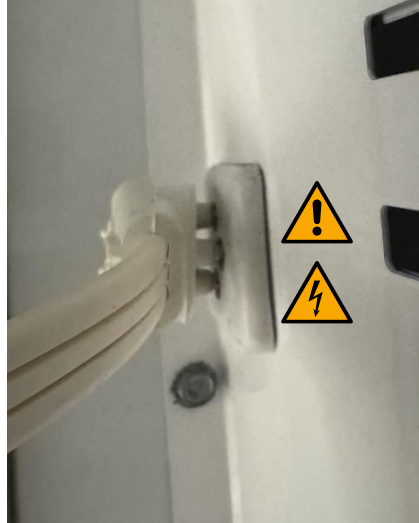
The image below shows an example of a shelf inserted into its support channel



4. Check each lamp bank's power cord for proper insertion into its corresponding female receptacle. The plug and receptacle are configured such that they can only be connected in one orientation.



Make sure each plug is fully seated into its receptacle with a firm press. Failure to fully seat a plug into its receptacle may cause the lamp bank or chamber electrical system to malfunction or become damaged.



(Plug not fully seated)



(Press plug firmly into receptacle)

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 drain 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 I-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 CU-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.

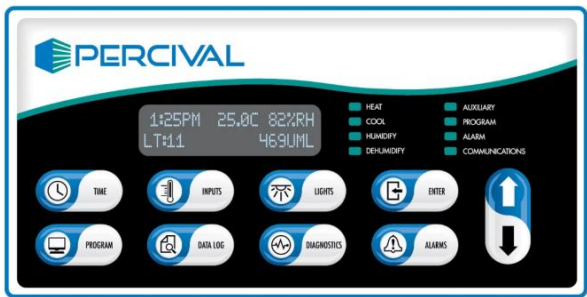
 Please refer to the supplementary **Touch Screen User Manual** for instructions on the operation of this optional system.

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	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.

Note: The keypad overlay (shown below) inside the control box is used for service purposes



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:

Calibration Offset = Calibration Standard Value – 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 where:

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

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

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

Any offsets with lights turned off are called Night Offsets and any offsets with any number 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 a CU-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 85 lbs (38.6 kg) on any CU-41 shelf
- Do not place more than 125 lbs (56.8 kg) on any CU-22, CU-36 or CU-66 shelf
- Do not place more than 500 lbs (227.3 kg) total in a chamber
- Be aware there are no stops sliding a shelf out too far and avoid cantilevering a weighted shelf



Avoid placing items in a unit that produce significant amounts of heat. CU-Series base model chambers are designed to accommodate a product heat load of 3 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.

Lighting

The standard lighting system provided with all CU-Series chambers is PC (PetriClear®), which consists of a finely tuned ratio of white and infrared LEDs evenly distributed across an array.



Please refer to the supplemental lighting system user manual provided with this document that corresponds with the lighting system option code ordered with the chamber. The standard lighting system is described by the **PC PetriClear® LED Lighting User Manual**. Other lighting system options may include one or more of the following: SW (SciWhite®), SB (SciBrite®), IW (IncuWhite®), IB (IncuBrite™), or X (Special)

Air Flow

Airflow across each tier in the CU-22, CU-36, and CU-41 Series base models is vertical and has been optimized for tissue culture applications. The chamber's temperature control system continuously circulates air throughout the controlled environment in the following manner:

1. Air is drawn into the ceiling-mounted evaporator coil for conditioning
2. Conditioned air is routed down the back of the chamber into a plenum assembly positioned below each shelf
3. Process air exits each plenum in a uniform, upward direction
4. After passing under and flowing through each lamp bank, process air returns upward at the front of the chamber, between the shelves and door, where it is drawn back into the evaporator coil for reconditioning
5. This special plenum design reduces unwanted formation of condensation inside petri dishes

For all CU-Series chamber models, air flow is tuned to provide sufficient capacity to remove excess heat from within the chamber and establish proper uniformity while minimizing disturbance to specimens.

Petri Dish Use

Petri dishes are commonly used in tissue culture chambers to provide a sterile, contained environment for the growth and observation of plant or animal tissues. They allow for easy handling, monitoring, and manipulation of cultured cells or explants under controlled environmental conditions.

Lid Condensation

The formation of condensation on Petri dish lids is a common problem in tissue culture chambers. When water vapor inside a dish encounters a surface with a temperature below the dew point, the vapor cools and condenses into droplets.

Why it's problematic:

1. Excess moisture can displace organisms, displace colonies and cause organisms to grow irregularly, making it difficult to accurately interpret results. Colonies may appear merged, overly spread, or submerged
2. Water droplets are a vector for the spread of microorganisms and the cross-contamination of samples
3. When droplets fall onto the agar surface, they introduce excess water into the medium. This can dilute nutrients, growth regulators and other media components relevant to tissue development or microbial growth
4. Any condensation adhering to the lid or agar surface can make it difficult to clearly observe cultures through the dish, obscuring early signs of contamination, morphological changes, and growth patterns, limiting accurate monitoring and documentation

Contributing Factors

As previously described, condensation forms in Petri dishes when the lid temperature is at or below the dew point of water vapor present within the dish. The following factors affect conditions within and surrounding Petri dishes in a controlled environment:

- Radiant energy from lights
- Air flow direction and velocity
- Dish position, orientation and loading on each shelf
- The rate at which environmental parameters are changed
- Temperature differential between dish media and chamber environment at the onset of an experiment
- The use of optional equipment packages (e.g. additive humidification systems)

These factors should be considered during the preparation and execution of experiments as the formation of condensation can be mitigated through regulation of these parameters.

Lid Condensation Mitigation Strategies

Percival's CU-Series tissue culture chambers include standard features that help mitigate the formation of condensation in Petri dishes. While these systems provide a solid foundation toward this end, their effectiveness is subject to how they're used. The major chamber features are described below and include recommendations on proper use toward the mitigation of condensation.

Airflow

Conditioned air is delivered to each shelf compartment in a CU-Series chamber via a highly refined plenum. Each plenum is tuned such that conditioned air is delivered equally to each tier uniformly, gently (i.e. low velocity) and with an upward direction.

Uniform airflow promotes good temperature uniformity throughout the controlled environment. Low velocity airflow helps to minimize the temperature difference between each dish and the surrounding chamber environment. Upward air flow further helps to reduce condensation. As conditioned air exits from the plenum it comes into contact with the underside of each dish, where the growing media acts as an insulator. This helps reduce the temperature differential between conditions inside each dish and its lid.

Recommendations for Use:

- If possible, do not stack Petri dishes. Stacking dishes does not allow uniform heat transfer between each dish and the surrounding chamber environment. When stacked, dishes insulate one another from conditions inside the controlled environment. Conditioned air does not properly flow over upper dishes in a stack. Heat and light do not properly penetrate into lower dishes, when stacked.
- Dishes should be evenly spaced across each shelf to retain uniform upward airflow
- When loaded, experiments should not cover more than approximately 80% of a shelf's surface area. This prevents the blocking or stagnation of airflow throughout the controlled environment.
- Shelves should be equally loaded with experiments to ensure process air is delivered equally to each tier

Lighting

Standard equipment on CU-Series chambers includes Percival's patent-pending PetriClear® LED lighting system. It is one of the most effective systems for reducing condensation in a controlled environment. The system consists of a circuit of dimmable white LEDs for illumination during day periods, and a circuit of infrared LEDs which increase Petri dish lid surface temperatures. For maximum utility, white PetriClear® lighting is dimmable, and provides higher light intensity that is typically required for tissue culture applications. Infrared lighting is energized continuously to create stable lid temperatures and has been optimized to have a minimal effect on biological specimens. Studies suggest that light in the visible region of the spectrum passes through Petri dish lids more effectively than light in the infrared region (not visible). Visible light heats up media and specimens within dishes whereas infrared light heats up the lid itself.

Recommendations for Use:

- Light in the visible spectrum should be reduced to the minimum intensity required for a given experiment. For a typical tissue culture experiment requiring $150\mu\text{mol}/\text{m}^2/\text{s}$ light intensity, PetriClear® lighting should be set between 75 – 90% output, depending on chamber model.
- Keep in mind that light intensity is specified at 15cm from the light canopy in CU-Series chambers. Note that the intensity scales with distance, so stacked petri dishes may have different results.
- It is advisable to calibrate the lights-on offset to this lower intensity, allowing approximately a 4-hour normalization period after a light change for conditions to settle.



Please refer to the supplemental lighting system user manual provided with this document that corresponds with the lighting system option code ordered with the chamber. The standard lighting system is described by the **PC PetriClear® LED Lighting User Manual**. Other lighting system options may include one or more of the following: SW (SciWhite®), SB (SciBrite®), IW (IncuWhite®), IB (IncuBrite™), or X (Special)

Environmental Control

Percival's IntellusUltra control system utilizes highly refined algorithms to accurately control environmental parameters in a chamber. The system is capable of tightly maintaining static process settings as well as achieving rapid dynamic changes to process values. Temperature and lighting systems respond to set point changes faster than (optional) humidity control systems. Small fluctuations in temperature can illicit relatively large amounts of instability in relative humidity.

Recommendations for Use:

- Use a multi-step program in ramping mode to smooth out abrupt changes in an experiment's temperature control profile
- Conduct analysis work during the lights-off (night) period, immediately before start of the day period, if possible



Refer to the **C8 Control System User Manual** for comprehensive operational instructions for the chamber's control system, and specific instructions on the configuration of programming and step modes.

Dish Preparation

The type, quantity and preparation of Petri dishes used in a CU-Series chamber is at the user's discretion.

Recommendations for Use:

- Use completely dry dishes to minimize excess moisture from getting trapped in the system
- Pour agar into dishes at a temperature as close to the experimental target temperature as possible. This will reduce the amount of water vapor released into the dish and minimize the temperature difference between dish and chamber
- Place dishes in a sterile environment with lids ajar to allow steam to escape

Maintenance

Performing regular maintenance on a controlled environment 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.

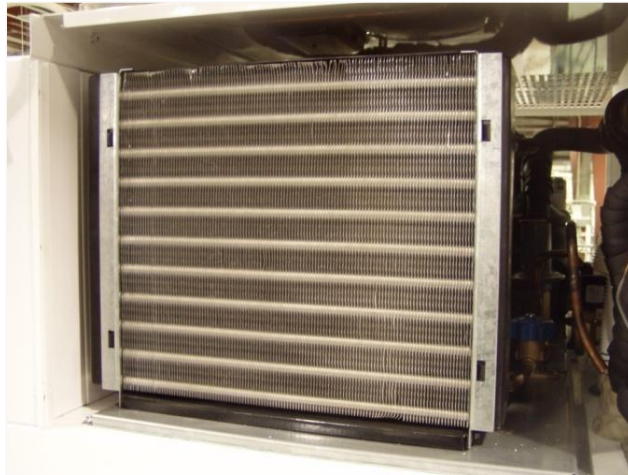


Please be aware that some parts of the condensing unit become hot while the unit is in operation and can remain hot for some time after the unit is powered down.

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 cover panel on the right side of the unit's mechanical section.



To access the condenser fan in a CU22, CU36, or AR41 Series incubator, remove the mechanical section's top cover(s) and/or rear panel(s).



Clean the Evaporator

The following steps and images are for reference on how to remove the evaporator cover to access the evaporator coil and air circulation fans located in the cover for cleaning.



1. Power down the unit
2. Unplug any lights or auxiliary equipment plugged into the chamber's receptacle panel that will prevent access to the evaporator
3. Remove lamp banks and shelving that may interfere with removing the cover. Pilaster clips can often be left in place
4. Remove the two outside sheet metal screws on the left that secure the evaporator cover to its housing and gently let it hang to access the fan wiring



5. Slide the clip with the ground (green) wire off the frame and unwrap it from around the other wires



6. Disconnect the neutral (white) wire from the ribbed wire that runs to the fans and the positive (black) wire from the smooth wire that also runs to the fans
Note: International chambers might have two black wires and no white. In this case the wires should be marked before disconnecting
7. Remove the other two screws holding the cover in place and set the cover with fans and screws to the side



8. Clean the evaporator coil by dislodging dirt and debris via soft brush, compressed air or vacuum, and inspect the condensate drain line for any cracks, wear or blockages.
9. Remove dust and debris from the evaporator fans and wipe any dirt or residue from inside the evaporator cover and housing
10. Reverse the steps to replace the cover, making sure to reconnect the wires as they were originally and wrap the ground wire around the others to keep it from getting into the fans

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



C8 – IntellusUltra® Control System Product Specifications

Percival Model: **ETC-109**

Specification Document: **2000-11-2-1**

1. System Hardware

- 1.1. Industrial grade, highly reliable, solid-state microcontroller architecture
- 1.2. Dual experiment protection via integrated, independent temperature limit shutdown
- 1.3. Single-board, electronic solid-state design
- 1.4. Primary micro-processor manages all control system functions
- 1.5. Secondary micro-processor provides a completely separate and redundant temperature limit monitoring system for experiment protection
- 1.6. High-visibility VFD display with 2 rows x 20 alphanumeric characters per row
- 1.7. Lithium-ion battery
- 1.8. Two USB ports for data transfer with external devices
- 1.9. One RJ45 Ethernet jack for data transfer with optional touchscreen (Option code T)
- 1.10. One connection block for connection of expansion modules
- 1.11. One connection block for DALI bus wiring
- 1.12. Keypad membrane overlay for menu navigation and configuration of all control system parameters

1.12.1. Industrial-grade construction

1.12.2. 10 Function keys

- 1.12.2.1. Time
- 1.12.2.2. Inputs
- 1.12.2.3. Lights
- 1.12.2.4. Program
- 1.12.2.5. Data Log (inactive on C8)
- 1.12.2.6. Diagnostics
- 1.12.2.7. Alarms
- 1.12.2.8. Enter
- 1.12.2.9. Up/Down navigation

1.12.3. LED process indicator lights

- 1.12.3.1. Heat (Red)
- 1.12.3.2. Cool (Blue)
- 1.12.3.3. Humidify (Red)
- 1.12.3.4. Dehumidify (Blue)
- 1.12.3.5. Auxiliary (Red)
- 1.12.3.6. Alarm (Red)
- 1.12.3.7. Communications (Blue)

2. Modes of Operation

2.1. Non-ramping

- 2.1.1. Programmed set points are achieved in a step-format. Current set point is held until the next scheduled step, at which point the new set points take effect

2.2. Ramping

- 2.2.1. Programmed set points are achieved in a ramp-format. Process values are linearly ramped between the previous and subsequent program steps

2.3. Manual

- 2.3.1. All manual set points are held static until changed
- 2.3.2. This mode of operation occurs when a program is not running
- 2.3.3. When a multi-step program or sequence is suspended, the current step is held as a manual set point until the program is restarted

3. Programming

3.1. Diurnal

- 3.1.1. Two step program sequence (Day and Night settings)
- 3.1.2. Linear program configuration menu structure
- 3.1.3. Program type is indicated on the controller main display, when running

3.2. 24 hour

- 3.2.1. Multi-step program
- 3.2.2. Time-based
- 3.2.3. Shortest time increment is 1 minute
- 3.2.4. Each program executes over a 24 hour day
- 3.2.5. Control system capable of storing up to 500 total steps which can be divided among up to 50 individual programs
- 3.2.6. A single program repeats indefinitely

3.3. Non-24 hour (elapsed time)

- 3.3.1. Multi-step program
- 3.3.2. Program steps executed in elapsed time
- 3.3.3. Shortest elapsed time increment is 1 min
- 3.3.4. Longest elapsed time increment is 999h:99m
- 3.3.5. Control system is capable of storing 60 total steps which can be divided among up to 20 individual programs
- 3.3.6. A single program repeats indefinitely

3.4. Daily Light Integral (DLI)

- 3.4.1. Only available with Q22 lighting control option (contact factory)
- 3.4.2. Two step program sequence
- 3.4.3. Linear menu structure for program configuration
- 3.4.4. Operates in a similar fashion to a Diurnal program
- 3.4.5. Program measures accrued light in mol/day and terminates the lighted (Day) step once the DLI set point has been satisfied

3.5. All multi-step programs can be run in ramping or non-ramping modes

3.6. Program Sequencing

- 3.6.1. Multiple programs can be linked together in a program sequence
- 3.6.2. Capable of storing up to 50 total sequence steps
- 3.6.3. Each sequence step consists of a multi-step program
- 3.6.4. User can define the number of iterations for each program in the sequence
- 3.6.5. The program sequence repeats indefinitely

4. Control Loops

4.1. Three standard control loops

4.1.1. Temperature

- 4.1.1.1. RTD temperature sensor inputs
- 4.1.1.2. Two outputs (Heat and Cool)
- 4.1.1.3. Configurable PID, On/Off, and Complementary control methods

4.1.2. Relative Humidity

- 4.1.2.1. mA or VDC input signal
- 4.1.2.2. Two outputs (Humidify and Dehumidify)
- 4.1.2.3. Configurable PID, On/Off control methods

4.1.3. Auxiliary

- 4.1.3.1. Universal input type (mA, mV, VDC)
- 4.1.3.2. Two outputs (ChA and ChB)
- 4.1.3.3. Configurable PID and On/Off control methods

4.2. Expandable with up to four additional control loops via expansion module(s)

4.2.1. Each expansion slot functions as a universal Auxiliary channel, per 4.1.3

5. Alarms

5.1. All alarms produce visual and audible notifications to users, when active

- 5.1.1. Integrated audio indicator produces an alarm tone
- 5.1.2. Alarm LED on control system overlay is illuminated
- 5.1.3. Alarm error codes and descriptions are displayed on the controller

5.2. Limit Alarms

- 5.2.1. Provide experiment protection from high and low temperature conditions
- 5.2.2. High and low limit thresholds are user-configurable
- 5.2.3. Limit thresholds are static (fixed)
- 5.2.4. Chamber sub-systems are automatically de-energized during an active limit alarm to prevent conditions from exceeding limit thresholds
- 5.2.5. Limit alarms are self-resetting. All chamber sub-systems are automatically re-energized once the process value is once again suitably within the limit thresholds
- 5.2.6. Primary temperature input is provided with high and low limit thresholds
- 5.2.7. Secondary temperature input is provided with high and low limit thresholds
- 5.2.8. Secondary temperature limit system provides redundancy for a second layer of experiment protection

5.3. Soft Alarms

- 5.3.1. Provide notifications to the user when alarm threshold(s) have been exceeded
- 5.3.2. High and/or low alarm threshold(s) are user-configurable
- 5.3.3. Alarm thresholds are static (fixed)
- 5.3.4. All soft alarms are by default disabled on the controller, but can be enabled at customer request
- 5.3.5. Soft alarm states can be used and the source for triggering internal logics on the controller

5.4. Sensor Error Alarms

- 5.4.1. Provide notifications to the user if a sensor input error is detected
- 5.4.2. Any channel input configured for an RTD sensor produces an input error if the input is shorted or open
- 5.4.3. Any channel input configured for a mA, Volt or mV sensor produces an input error based upon the factory level Process Error setting
- 5.4.4. If the Process Error Enable setting is set to 'No', the sensor error alarm feature is disabled

5.5. Deviation Alarm

- 5.5.1. Deviation alarm uses the primary temperature input process value
- 5.5.2. Can be enabled and disabled at the user level
- 5.5.3. High and low alarm thresholds are user-definable

- 5.5.4. Alarm thresholds define a tolerance band that follows the process set point
- 5.5.5. The alarm becomes active when the process value goes outside of the specified tolerance band
- 5.5.6. Alarms can be set to latching or non-latching
 - 5.5.6.1. Latching alarm setting retains the alarm notification on the controller display until it is acknowledged by the user
 - 5.5.6.2. Non-latching clears the alarm notification automatically, once the process value re-enters the deviation tolerance band

5.6. Light Lifetime Alarm

- 5.6.1. Provides audible and visual notifications on the control system if the light lifetime alarm threshold has been exceeded
- 5.6.2. Alarm thresholds are user-definable
- 5.6.3. Alarms must be manually cleared by resetting accrued light lifetime value(s)

6. Calibration

- 6.1. All analog inputs can be calibrated for lights on and off (day/night) operation
- 6.2. All calibration settings are user-definable
- 6.3. Primary temperature and relative humidity (if applicable) channel(s) calibrated to NIST standard devices, prior to shipment from Percival.
- 6.4. Primary temperature control channel can be calibrated via single (standard) or multi-point offsets
 - 6.4.1. Multi-point calibration offsets allow for the user to define up to three calibration zones based on the temperature range and process value, which linearly interpolate for an offset.
 - 6.4.2. Each zone receives its own day/night calibration offset

7. Defrost Sequencing

- 7.1. For low temperature applications/options, when deicing of chamber systems becomes necessary
- 7.2. Quantity, initiation time, and duration of defrost periods are user-definable
- 7.3. Intelligent evaporator coil defrost sequencing for low temperature applications
 - 7.3.1. User-settable defrost event times and durations
 - 7.3.2. Evaporator pre-cooling sequence
 - 7.3.3. Automatic, logic-based defrost initiation, and termination sequencing
 - 7.3.4. Automatic switching between active and inactive, dual coil evaporator systems (contact factory)

8. System Diagnostics

- 8.1. System diagnostics menu
- 8.2. Ambient temperature monitoring
- 8.3. Power fail event logging
- 8.4. Light lifetime maintenance
 - 8.4.1. Accumulated hours that each light output has been activated are retained
 - 8.4.2. Accumulated hour values can be individually reset for each output

9. Security

- 9.1. Controller can be secured with four-levels of password protection
 - 9.1.1. Level 4, which allows access to
 - 9.1.1.1. Main display loop controls
 - 9.1.1.2. Security login menu
 - 9.1.2. Level 3, which allows access to
 - 9.1.2.1. All Level 4 items
 - 9.1.2.2. User setup menu
 - 9.1.2.3. Alarm menus
 - 9.1.2.4. Diagnostics menus
 - 9.1.3. Level 2, which allows access to
 - 9.1.3.1. All Level 3 and 4 items
 - 9.1.3.2. All other user menus
 - 9.1.4. Level 1, which allows access to all menus as if security was disabled

10. Battery Backup

- 10.1. Allows real-time internal clock module to maintain time during power-down periods
- 10.2. Deviation alarm latched state retained in RAM
- 10.3. Multi-step program information retained for seamless re-establishment of active operating modes and programs after power-down periods
 - 10.3.1. Active multi-step program mode retained in RAM
 - 10.3.2. Active multi-step program and sequence information retained in RAM

11. Communications

- 11.1. Not available on this product

12. Data Logging

- 12.1. 24 hour volatile log accessible only via touchscreen (see detailed specification T – Touchscreen Graphical User Interface) for graphing purposes

13. Additional Features

- 13.1. Field-upgradeable I/O expansion modules
- 13.2. Firmware updates via external USB port and thumb drive
- 13.3. Digital Addressable Lighting Interface (DALI)
 - 13.3.1. Allows for control of addressable DALI slave devices on a two wire signal bus
 - 13.3.2. Ability to commission DALI addresses, allowing the remapping of lights/events without the need for rewiring
- 13.4. Plug-and-play, optional touchscreen user interface (see detailed specification T- Touchscreen Graphical User Interface)
- 13.5. Backward compatibility with previous-generation Intellus control systems
- 13.6. Light lifetime accrual
 - 13.6.1. The control system automatically logs the total amount of time any light event is set to 'on'.
 - 13.6.2. Intended purpose is for lighting system maintenance
 - 13.6.3. Light lifetime is measured in hours
 - 13.6.4. Light lifetime values can be reset by the user
- 13.7. Retransmit of process values
- 13.8. Retransmit of set points
- 13.9. Retransmit of light power levels



PC – PetriClear® LED Lighting

Operator's Manual

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

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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.

Information contained within this supplemental user manual shall supersede any conflicting information contained within the basic chamber user manual.



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

Revision Log

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Rev A	2/19/2025	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 of 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’, ‘Panel’, ‘Tile’, and ‘Light’ are used interchangeably in this manual to describe the SciWhite® Series 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-wide 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.

PetriClear® LED modules are a patent-pending lighting system designed specifically for use in Percival Scientific’s CU Series tissue culture chambers. The lighting system consists of general-purpose cool white LEDs that provide light in the visible spectrum, specifically PAR (400-700nm). Specially tuned infrared LED chips are utilized to abate the formation of condensation inside petri dish lids.

Construction

PetriClear® LEDs are offered in a 12 x 24 in nominal form factor and share a common design with SciWhite® Series hardware which consists of an aluminum substrate, a layer with etched circuits onto which LED chips are soldered, and a conformal coating which provides a protective outer layer.

Mounting of Individual Panels

PetriClear® LED modules are integrated into lamp banks that are mounted horizontally above each tissue culture shelf. Each LED panel must be affixed to a flat surface for proper thermal management.



Heat produced by a PetriClear® LED panel is dissipated through its aluminum substrate. Each panel should be installed such that the exposed aluminum side, opposite of the LED chips, is brought fully into contact with the mounting surface.

PetriClear® LED panels are pre-installed into chamber light fixtures at Percival's manufacturing facility. However, should the need arise, individual panels can be removed from a light fixture with a few basic tools:

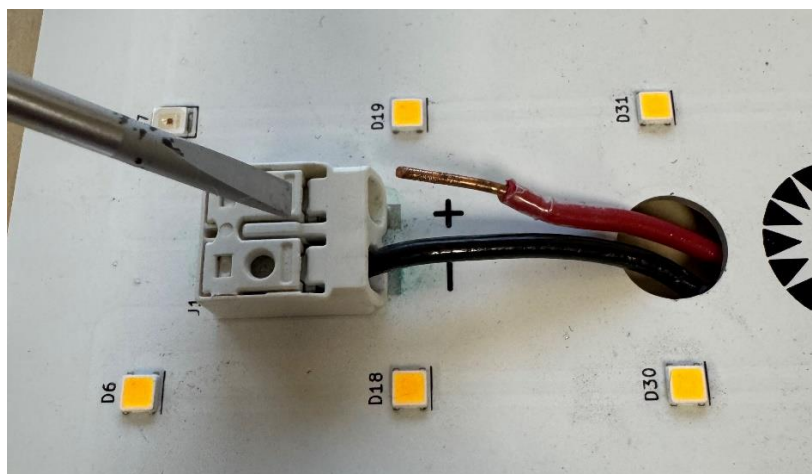
- 1/8" (or smaller) flathead screwdriver
- #2 Philips screwdriver

LED Panel Removal and Reinstallation

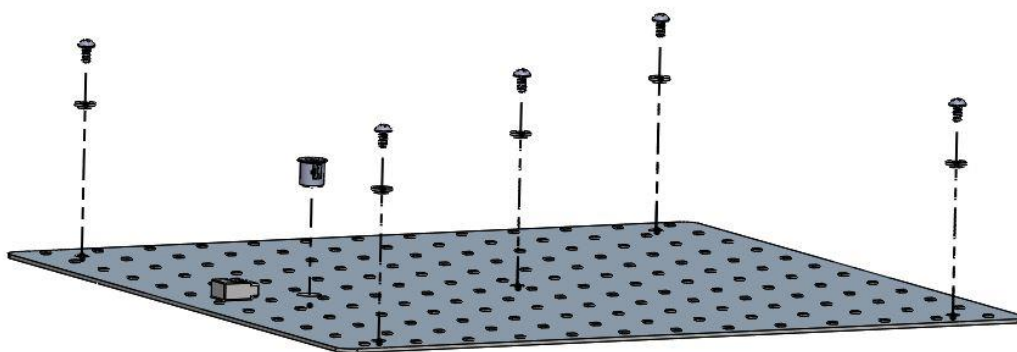


Ensure chamber power is turned off, and lamp banks are unplugged prior to any cleaning or service efforts.

1. Remove electrical wiring from the LED panel's connection terminals
 - a. Wiring is secured via spring clamps, located inside each wire terminal connection point
 - b. To open the spring clamp, apply pressure to the terminal with a small flat-head screwdriver as shown in the following image



- c. Wiggle the wire free from its terminal while applying pressure with a 1/8" flat head screwdriver
2. Remove all LED panel fasteners and shoulder washers with a Philips screwdriver
3. Pull the LED panel free from its mounting surface, allowing for the freed electrical wires to pull through the wire pass-through hole and grommet (not shown in the photo above).



(SW 12 x 12 in panel shown for reference)

4. To reinstall a PC panel onto its mounting surface, perform the disassembly steps above in reverse order. It is very important to ensure that:
 - a. Wiring must be fully inserted into the properly marked terminal. No exposed copper should be left visible at each connection point
 - b. Fasteners are self-threading and must not be over-tightened



Technical Specifications

White LED Chip Color

White LED chip output may vary according to the table below, resulting in perceptible differences in color from diode-to-diode and panel-to-panel.

Nominal CCT (ANSI C78.377A)	
CCT	CCT Range
2700 K	2725 K $\pm$ 145
3000 K	3045 K $\pm$ 175
3500 K	3465 K $\pm$ 245
4000 K	3985 K $\pm$ 275
4500 K	4503 K $\pm$ 243
5000 K	5028 K $\pm$ 283
5700 K	5665 K $\pm$ 355
6500 K	6530 K $\pm$ 510

PC - PetriClear® (12 x 24) Panel

Dimensions: 11.75 in (29.85 cm) x 24 in (60.96 cm)

Channel 1: Cool White

LED chip type: mid-power, cool white

CCT: 5700K

CIE 1931 (x,y): (0.330 $\pm$ 0.01, 0.345 $\pm$ 0.025)

LED Panel Voltage: 35.75V

Driver Type: Constant current

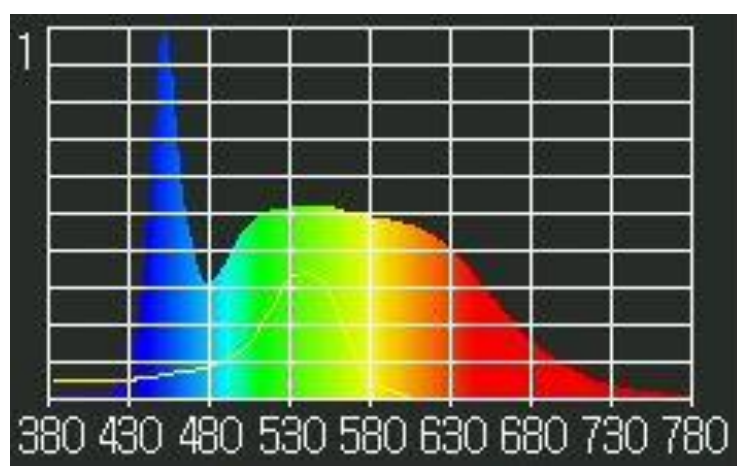
Control Range:

Chamber Series	LED Control Range
CU-22	5 – 100%
CU-30	5 – 100%
CU-36	5 – 100%
CU-41	10 – 100%

Spectral output:

Color	Wavelength Range (nm)	Ratio (%)
Blue	400-500	25
Green	500-600	43
Red	600-700	29
Far Red	700-800	3

Spectrograph:



Channel 2: Infrared

LED chip type: low power, infrared

Wavelength peak: 860 nm

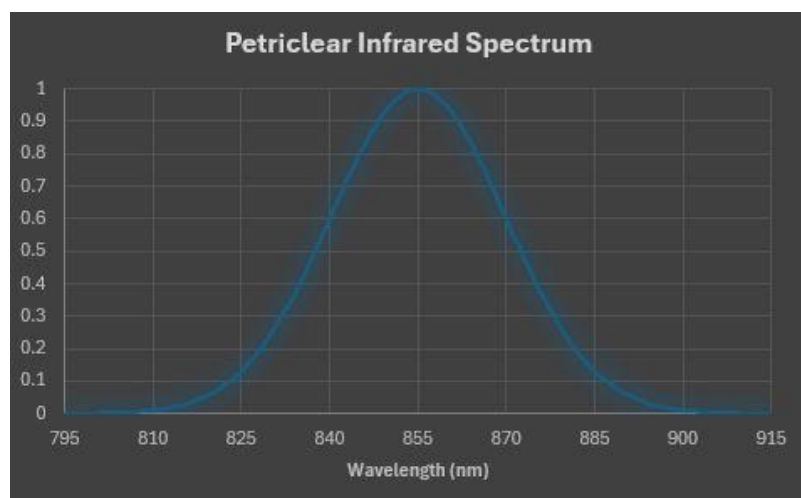
Half-wavelength width: 35 nm

LED Panel Voltage: 35.75V

Driver Type: Constant current

Control range: LEDs are constantly kept at 100% output

Spectrograph:



PetriClear® Lamp Banks

PetriClear® LED panels are populated into lamp bank assemblies that fit into CU Series tissue culture chambers. Lamp banks consist of a white, epoxy coated sheet metal housing which provides protection, structural support, wire management, heat dissipation and light reflection. When properly installed, the lamp bank assemblies orient PetriClear® panels to properly illuminate each tier from above.

Installation

All PetriClear® lighting ships pre-installed from Percival's factory and requires no installation by the User. Prior to first use:

1. Remove and discard all cardboard shims and foam blocks used to secure lamp banks during shipping.
2. Make sure lamp banks are not askew. Each lamp bank should rest evenly onto its support rails and be fully inserted such that it comes into contact with the chamber's interior rear panels.

The images below show an example of a properly installed above-shelf, horizontal SciWhite® Series lamp banks:



(CU-36L4 w/ PC Lighting)

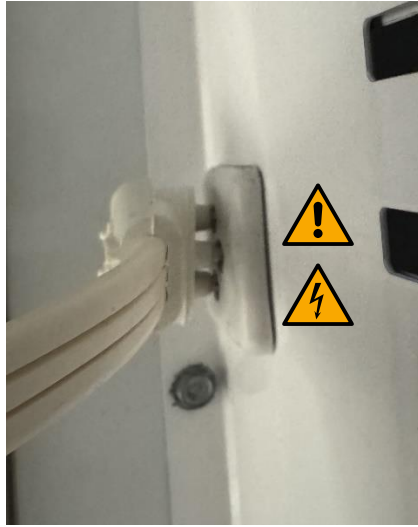


Ensure chamber power is turned off, prior to plugging in lamp banks

3. If unplugged, insert the male power plug of each lamp bank into its corresponding female receptacle. The plug and receptacle are configured such that they can only be connected in one orientation.



Make sure each plug is fully seated into its receptacle with a firm press. Failure to fully seat a receptacle into its receptacle may cause the lamp bank or chamber electrical system to malfunction or become damaged.



(Plug not fully seated)



(Press plug firmly into receptacle)

Operation

White LED Circuit

PetriClear® White 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.

PetriClear® Series LEDs are dimmable in 1% increments. Standard dimming range is dependent upon chamber base model.

The CU-41 series chamber model has a dimming range of 10 – 100%
All other CU series chamber models have a dimming range of 5 – 100%

Any set point less than the low dimming threshold percentage will de-energize the light output and turn off the associated white LED lighting circuit(s).

The factory default setting for PetriClear® white LED lighting is off.

To operate the PetriClear® 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.

Infrared LED Circuit

PetriClear® infrared LEDs are optimized to reduce condensation formation inside petri dish lids during both day (i.e. white LEDs energized) and night (i.e. white LEDs de-energized) periods and require no user input. The infrared LED channel always remains energized, and no means of control for this circuit are provided to the User.

The factory default setting for PetriClear® infrared LED lighting is on.



Infrared LEDs are not visible by the human eye. Operation of the infrared LED circuit cannot be assessed by visual inspection.

Maintenance

PetriClear® LED modules require minimal maintenance. If cleaning becomes necessary:

- 1) Turn off chamber power
- 2) Unplug the lamp bank
- 3) Slide the lamp bank out of the chamber
- 4) Inspect and clean the lamp bank sheet metal housing (avoid the LED panels) according to the general cleaning guidelines described in the base chamber user manual.



Prevent any liquid from getting inside the lamp bank housing through its vent holes.

- 5) Gently clean LED panels only with a soft, dry microfiber cloth
- 6) Once clean, plug in the lamp bank and chamber

The IntellusUltra control system keeps track of the total hours the PetriClear® white LEDs are 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

Document Control Table

[illegible]

Approvals

Percival Engineering

Signature

Title

Date

Percival Product Management

Signature

Title

Date

Percival Sales & Marketing

Signature

Title

Date

1. General

- 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]



Q4 – Door Lock

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 in order 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.

Information contained within this supplemental user manual shall supersede any conflicting information contained within the basic chamber user manual.



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

Revision Log

Version	Date	Description
Rev A	7/16/2024	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 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
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- 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

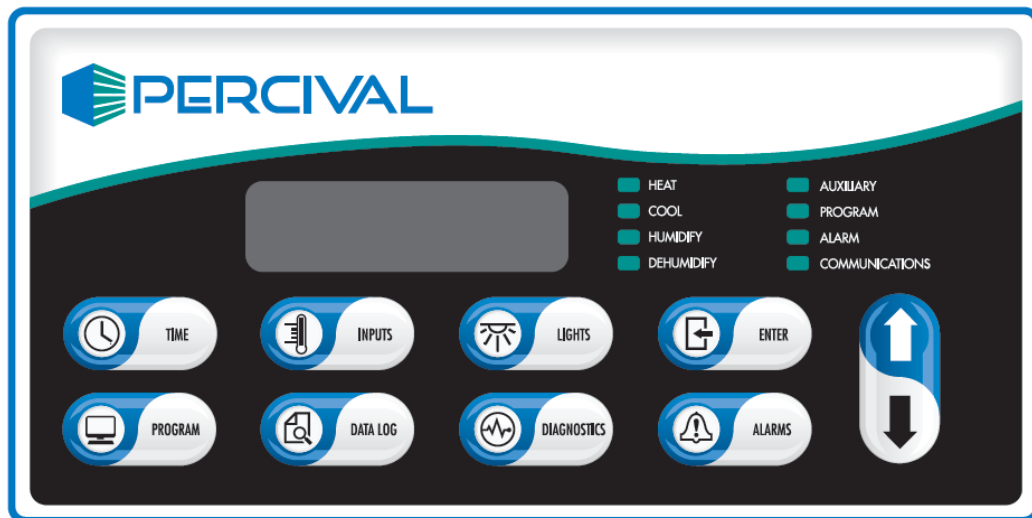
Email: parts@percival-scientific.com

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

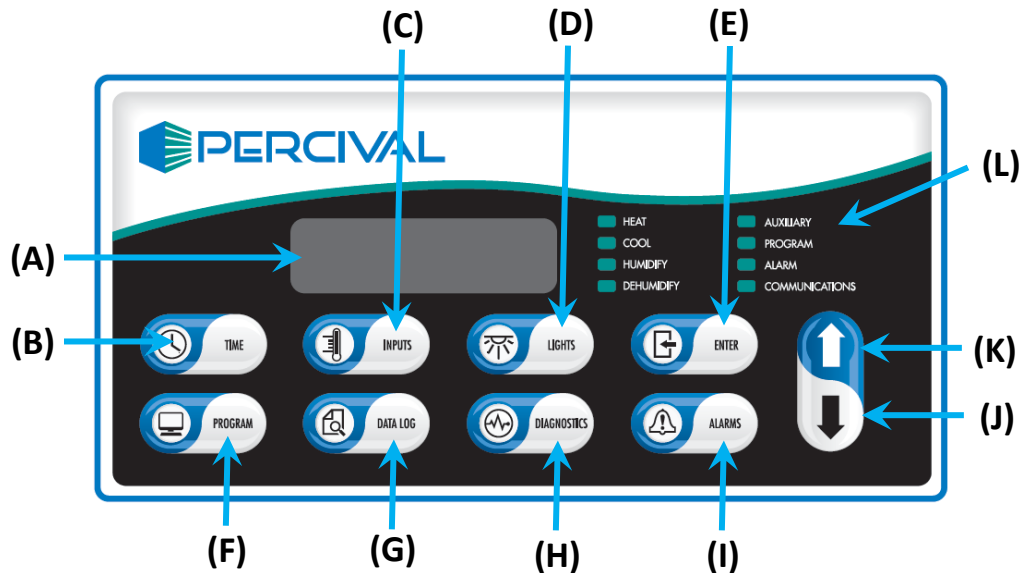


Figure 1 – IntellusUltra Display and Key Reference

(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**.

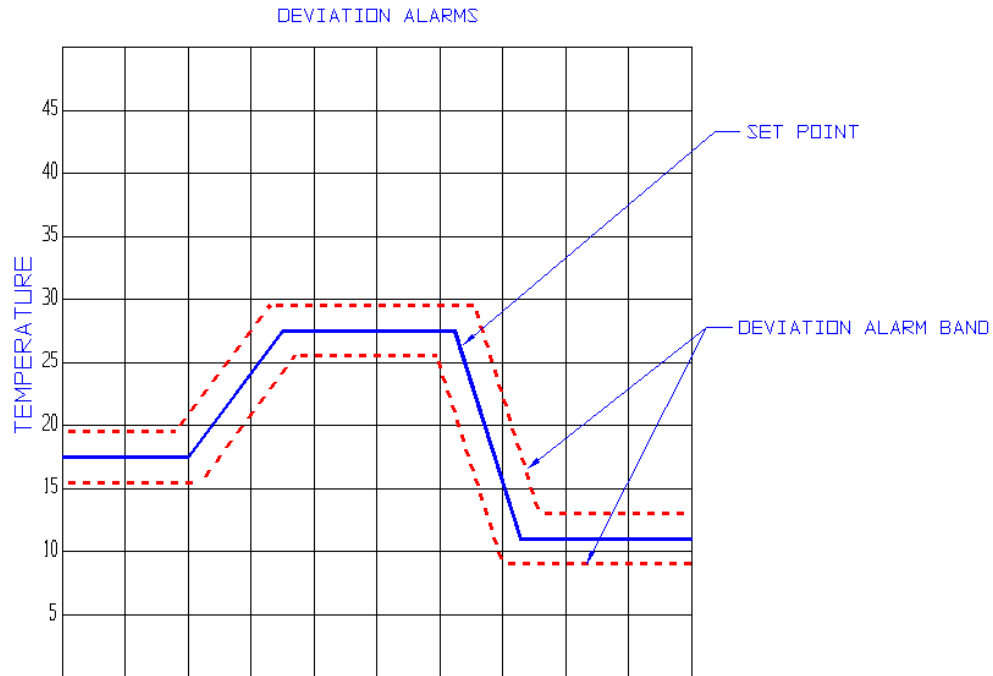


Figure 3 – Ramping Deviation Alarms Example

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**.

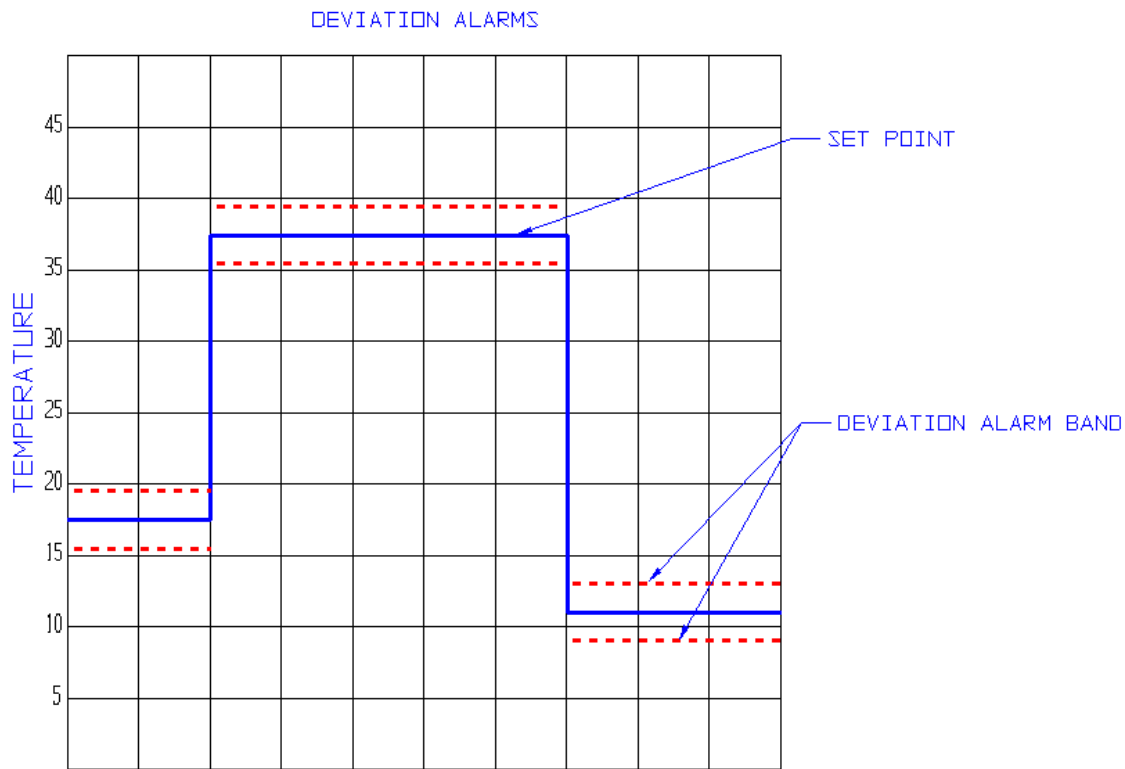


Figure 4 – Non-Ramping Deviation Alarms Example

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.

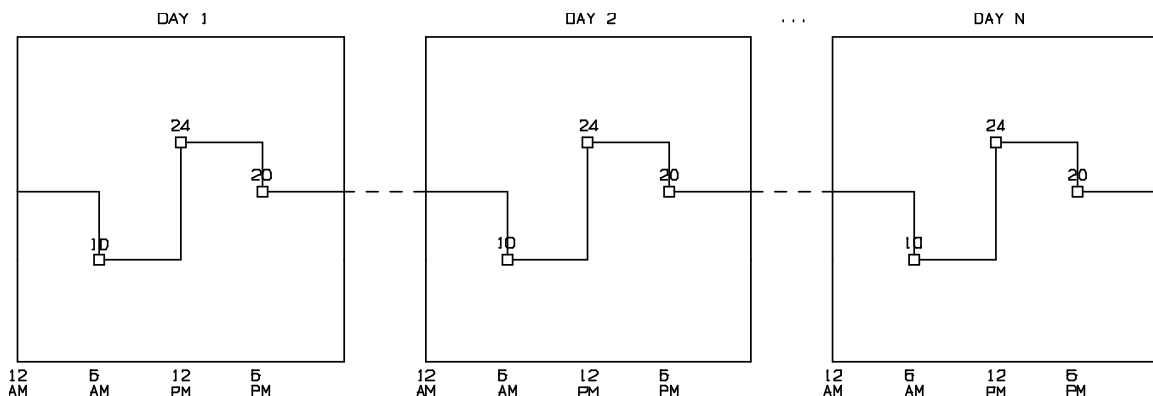


Figure 5 – Sample non-ramping program

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.

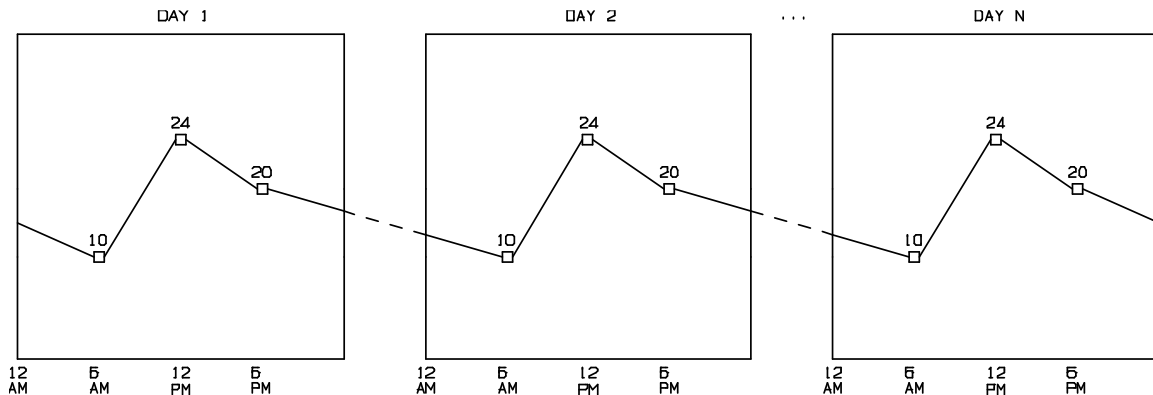


Figure 6 – Sample ramping program

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.

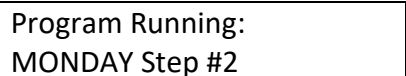
Running a Program / Sequence of Programs

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
---------	-----

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).
- **RM4 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.

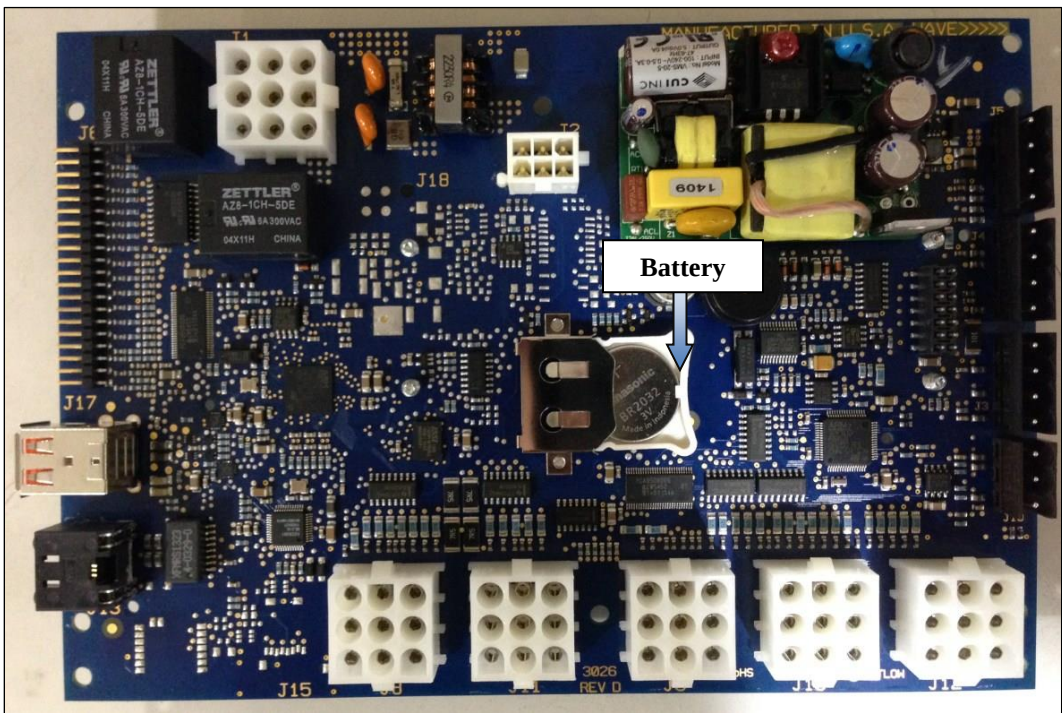
Battery Backup

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.

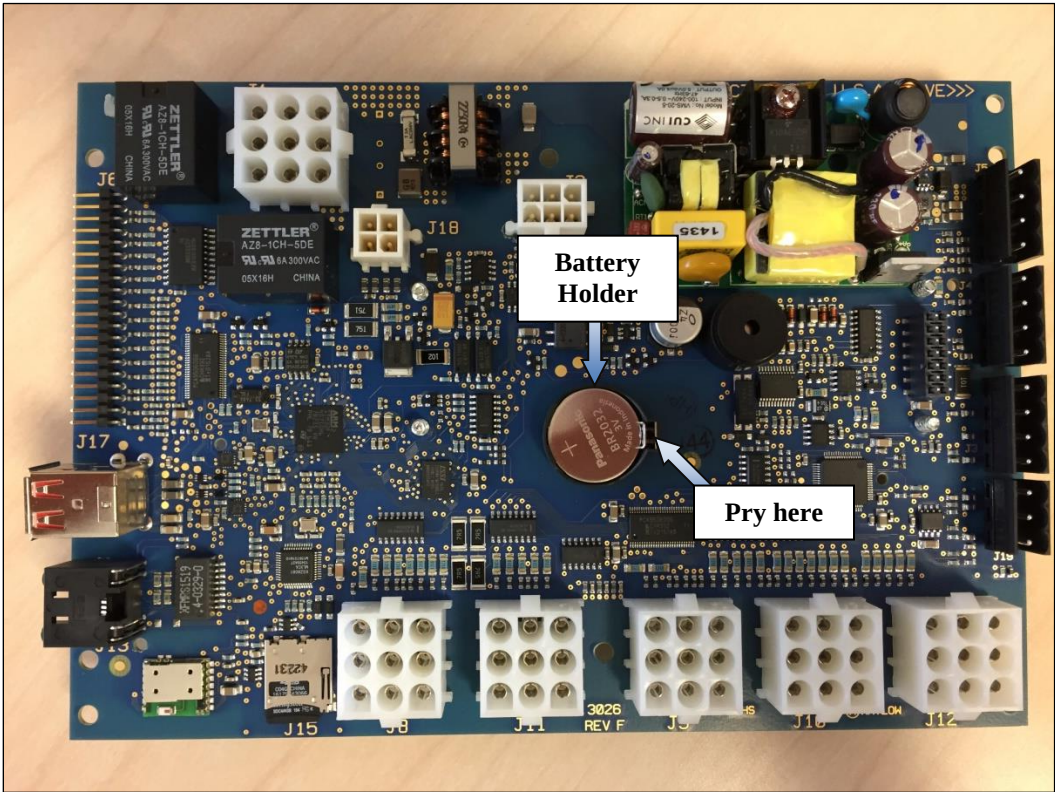
The approximate life expectancy of the battery is 7 years. It is recommended that the battery be replaced every 5 years to prevent the controller from losing its volatile memory contents when power is not applied.

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	Hyocyamus 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
Olive	Olea europaea	700	14	35.28	23	18

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)
	L.					
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 multiflorum 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
Soybean	Glycine max (L.)	450	20	32.4	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)
	Merr					
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
Cabbage	Brassica	700	14	35.28	8	8

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)
	oleraceae var.L					
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
Gloxinia	Sinningia	450	12	19.44	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)
	speciosa (Lodd.) Hiem					
Grape	Vitus spp.	700	20	50.4	25	20
Henbane	Hyocyamus niger L.	450	16	25.92	23	20
Hydrangea	Hydrangea macrophylla (Thunb.) Ser.	450	14	22.68	25	15
Kalanchoe	Kalanchoe blossfeldiana Poelein.	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
Poinsettia	Euphorbia pulcherrima Willd.ex Klotzch	450	10	16.2	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)
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 mulitflorum 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.)

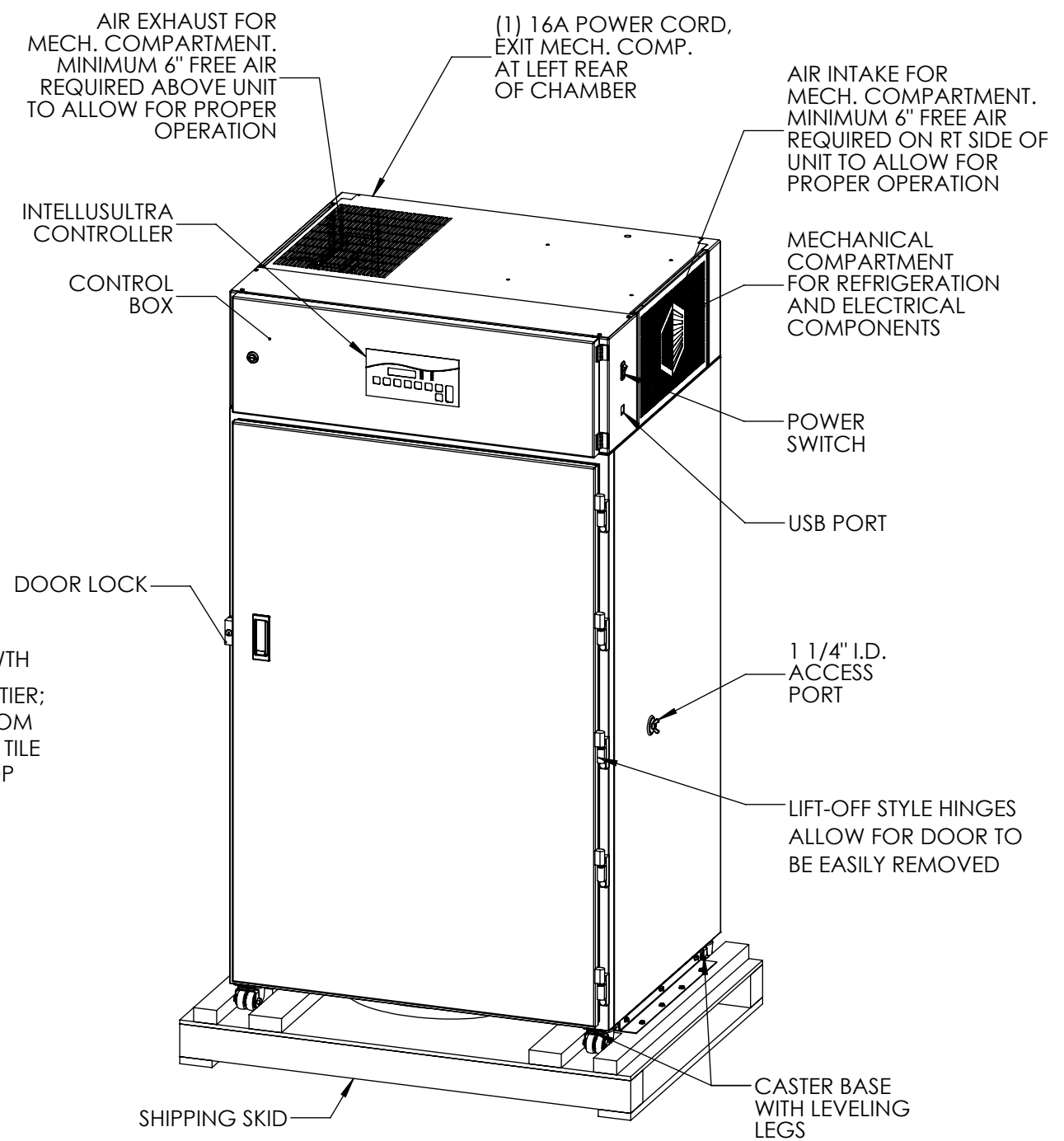
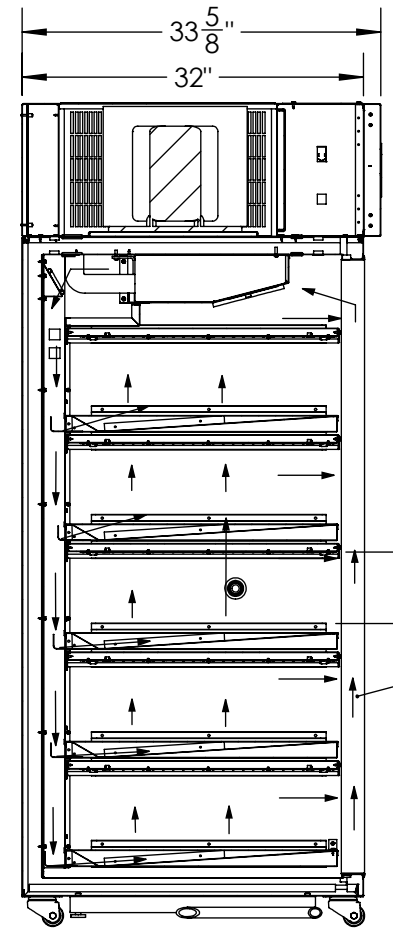
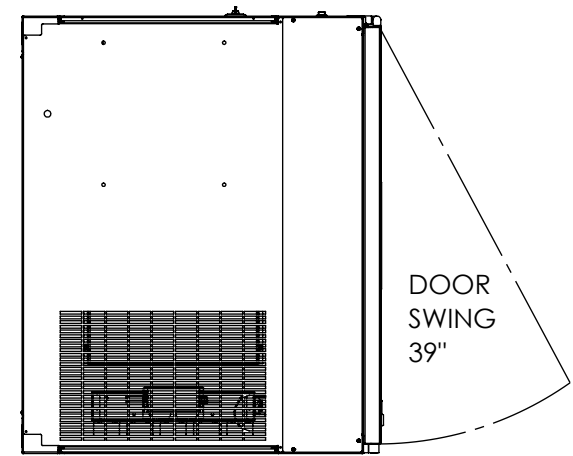
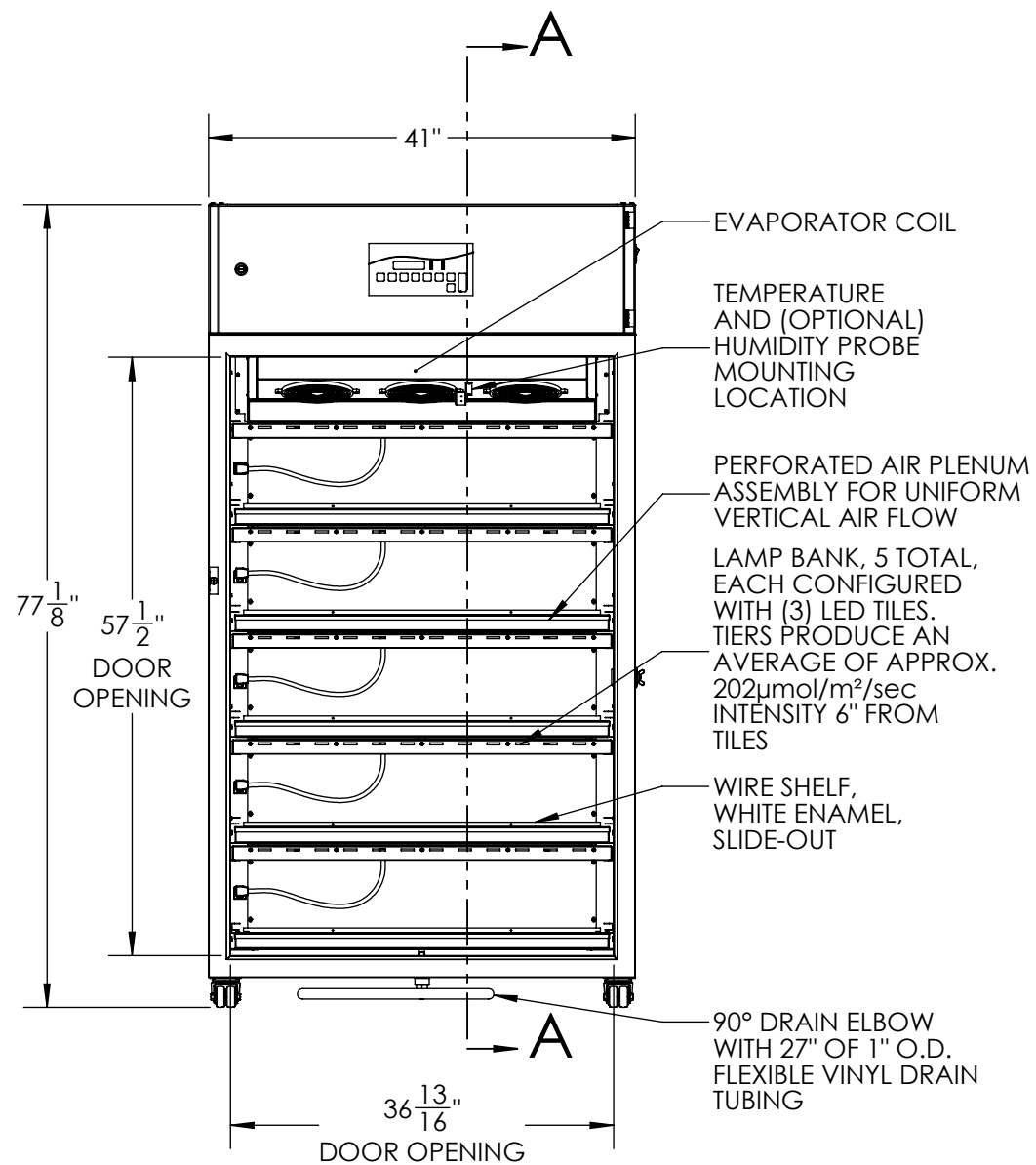
PLANT	PLANT	Fruit/Seed Dev.	Fruit/Seed Dev.	Fruit/Seed Dev.	Fruit/Seed Dev.	Fruit/Seed Dev.
Common name	Scientific name	PPF	Photoperiod (Hrs/day)	DLI (mol/m ² /day)	Temp °C (light)	Temp °C (dark)
Alfalfa	Medicago sativa	450	16	25.92	25	25
Annual Bluegrass	Poa annua	450	20	32.4		
Apple	Malus domestica	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

[illegible]

User Notes / Password Log:

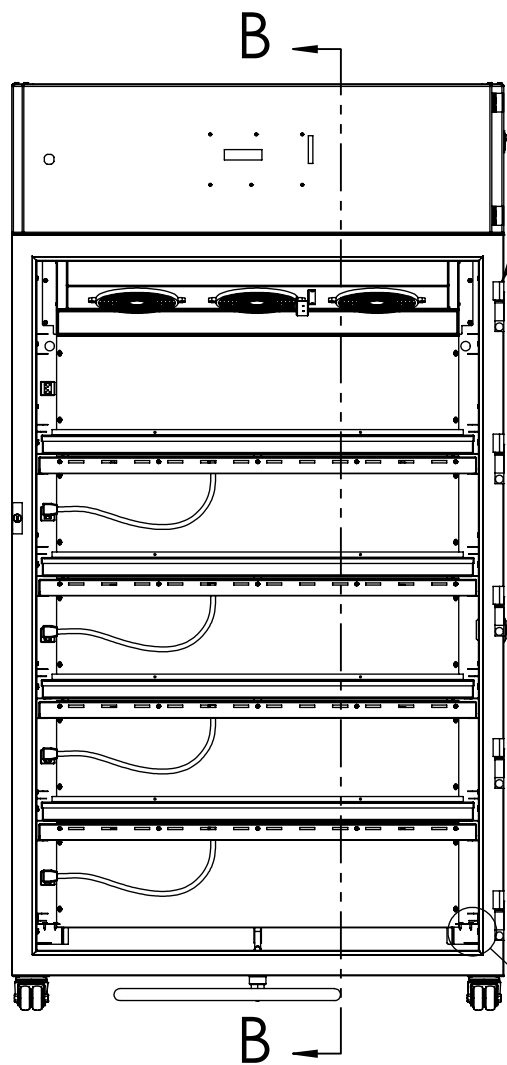
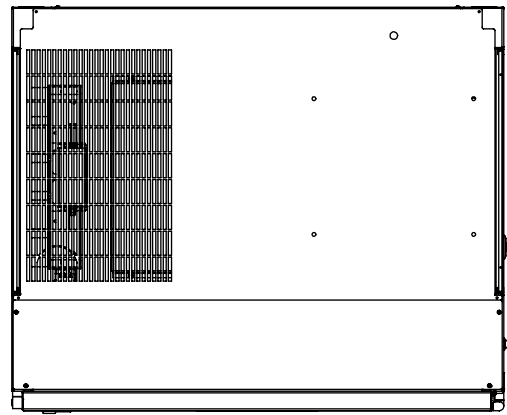


ELECTRICAL REQUIREMENTS:
SERVICE: 230/1/50, 8.8A RLA (11.0A MCA)
CORD #1: H05VVF, 15ft LENGTH, 16A

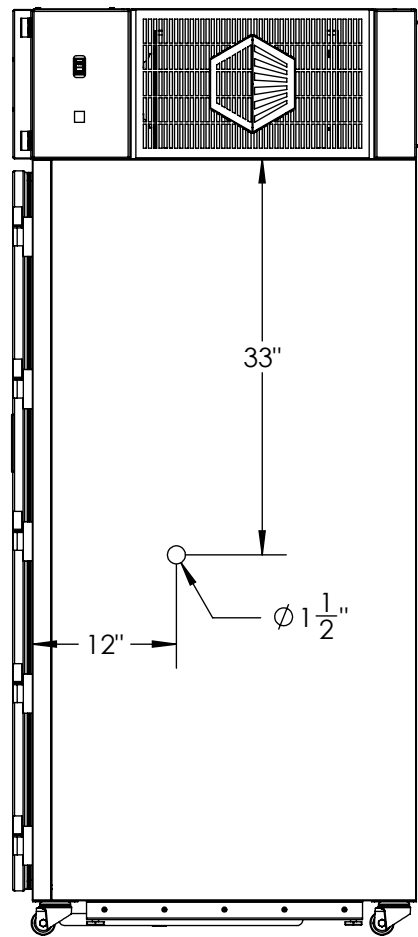
HEAT REJECTION TO AMBIENT:
3,924 BTU/H (1154 W)

PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS 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. PERCIVAL PERRY, IOWA		
TITLE: GENERAL ASS'Y		REV: R1
DRAWING: 036171-10		PART BY: EJ
MODEL: CU-41L5		DRAWING BY: RS
DATE APPROVED: 12/17/2025		SHEET 1 OF 2

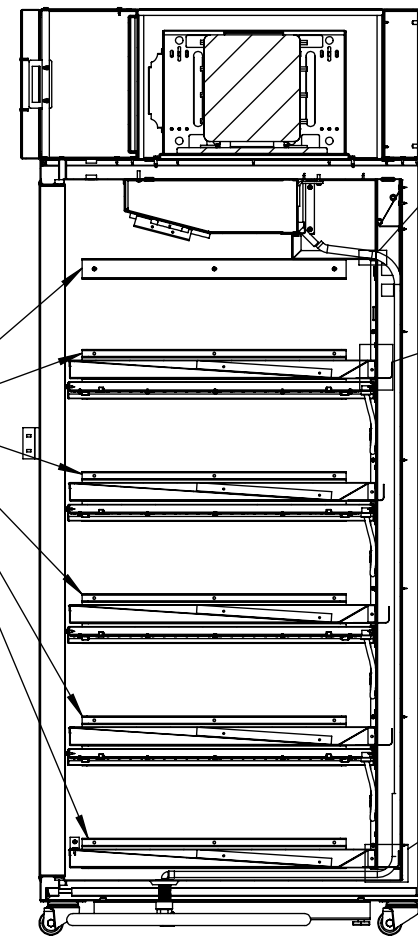
UNLESS OTHERWISE SPECIFIED:
ALL DIMENSIONS ARE IN INCHES
DRAWING IS NOT TO SCALE
FRACTIONAL TOLERANCE $\pm 1/32"$
ANGULAR (BENDS) $\pm 0.5^\circ$
DECIMAL VALUES ± 0.015



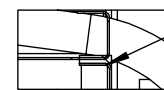
USE JIG TO
LOCATE HINGES



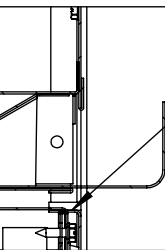
USE JIG TO LOCATE
FIXTURE SUPPORTS



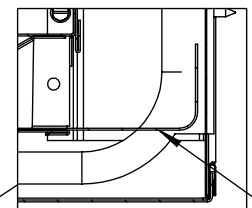
SECTION B-B



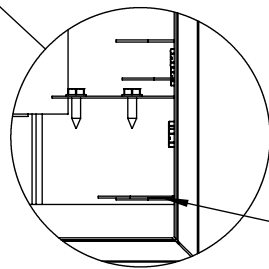
SLIDE TOP REAR
AIR BLOCK UP
UNTIL GASKET FORMS
A TIGHT SEAL WITH
DRIP PAN



SLIDE REMAINING AIR
BLOCKS UP SO
GASKET FORMS A
SEAL WITH PLENUM,
BUT PLENUM MAY BE
REMOVED WITHOUT
DAMAGE TO GASKET
OCCURRING



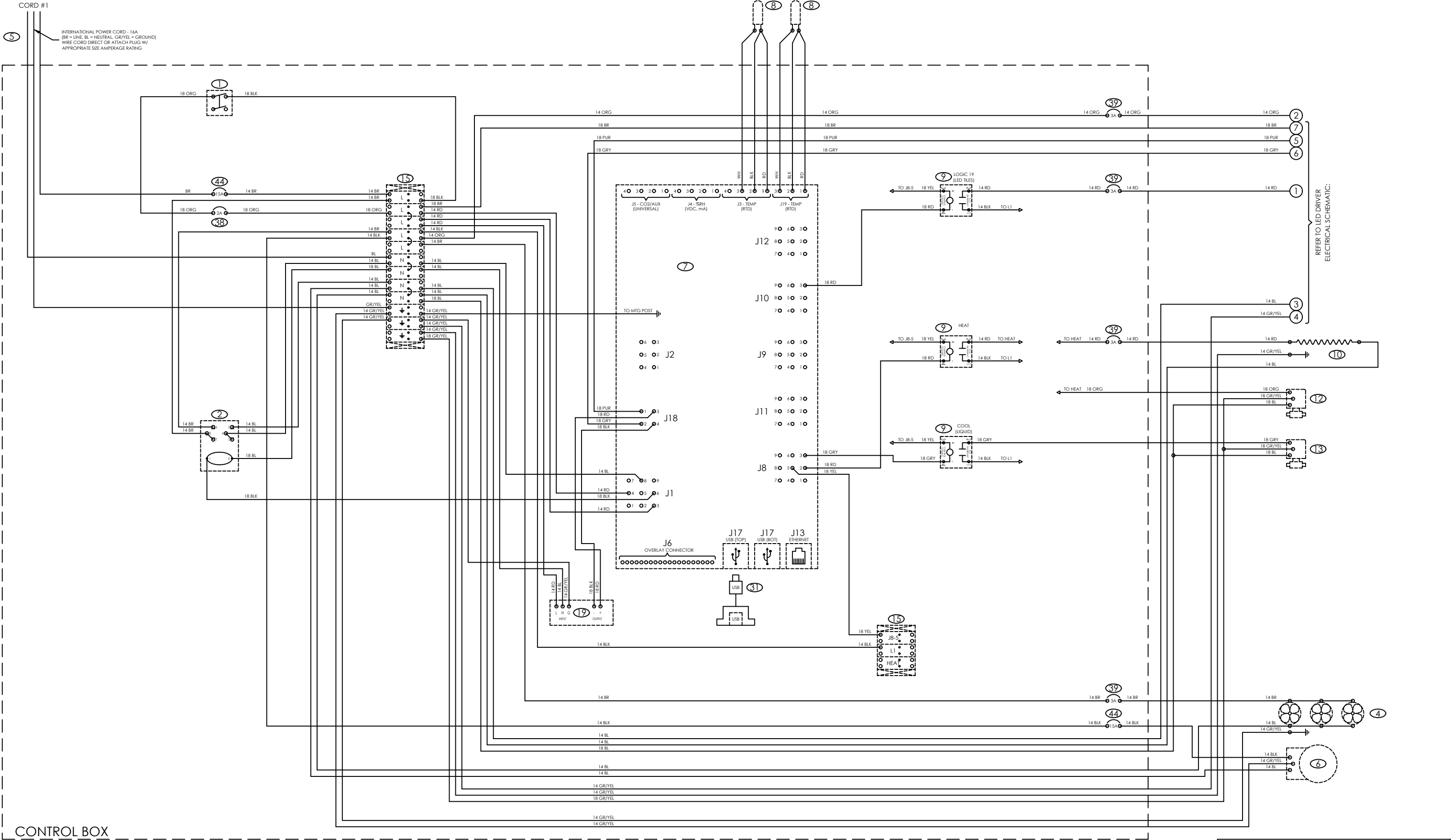
BOTTOM LOUVER
NOTCHED TO ALLOW
FOR DRAIN LINE



SHIPPING CLIP (95-3-300-4) ATTACHED
ON BOTH SIDES OF THE BOTTOM
HORIZONTAL AIR PLENUM SLIDER

DETAIL E

PROPRIETARY AND CONFIDENTIAL THE INFORMATION CONTAINED IN THIS 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	
UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES DRAWING IS NOT TO SCALE FRACTIONAL TOLERANCE ±1/32" ANGULAR (BENDS) ±0.5° DECIMAL VALUES ±0.015	TITLE: GENERAL ASS'Y		REV: R1
	DRAWING: 036171-10		PART BY: EJ
	MODEL: CU-41L5		DRAWING BY: RS
	DATE APPROVED: 12/17/2025		SHEET 2 OF 2



CONTROL BOX

- 1 - POWER SWITCH - DPST, 10/20A, 125/250VAC (ESW-130)
- 2 - POWER RELAY - DPDT, 30A, 240VAC (ERL-030)
- 3 -
- 4 - UNIT COOLER - 1.2A, 220V, 50/60Hz (RCO-084)
- 5 - POWER CORD - H05VVF, 3-WIRE, 16A, 250VAC (ECD-024)
- 6 - CONDENSING UNIT - 4.4A, 220/1/50 (RCU-313)
- 7 - CONTROLLER W/ OVERLAY - INTELLUS, 85-264VAC, 50/60Hz (ETC-094 & ETC-109)
- 8 - TEMPERATURE SENSOR - RTD, 100 Ohm, 0.00385 Ohm/Ohm/°C (ETC-052)
- 9 - RELAY - CARLO GAVAZZI, SS, NO, 3-32VDC INPUT, 24-240VAC OUTPUT, 5A (ERL-060)
- 10 - HEATING HEATER - 350W @ 230VAC, 1.52A (EHE-053)
- 11 -
- 12 - SOLENOID VALVE - HOT GAS LINE, 240VAC (RVS-027, -028, -031)
- 13 - SOLENOID VALVE - LIQUID LINE, 240VAC (RVS-027, -028, -030)
- 14 -
- 15 - TERMINAL BLOCK - WAGO, SERIES 2004, AWG 20-10, 30A, 600V

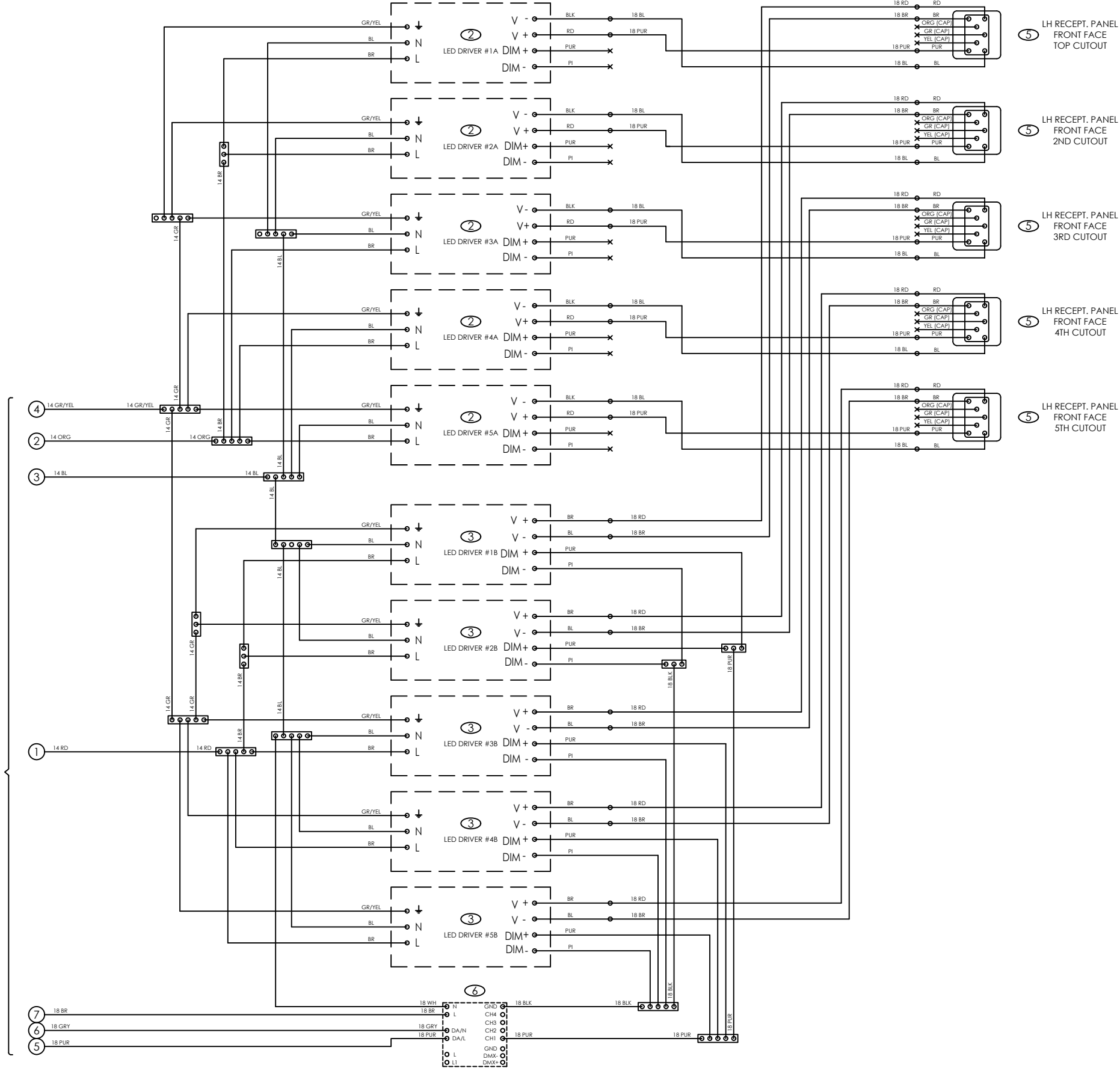
- 16 -
- 17 -
- 18 -
- 19 - POWER SUPPLY - 85-264VAC INPUT, 12VDC OUTPUT, 72W (EPS-031)
- 20 -
- 21 -
- 22 -
- 23 -
- 24 -
- 25 -
- 26 -
- 27 -
- 28 -
- 29 -
- 30 -

- 31 - CABLE - USB, PANEL MOUNT, USB A-A, FEMALE-MALE, 3ft LENGTH (EPC-032)
- 32 -
- 33 -
- 34 -
- 35 -
- 36 -
- 37 -
- 38 - CIRCUIT BREAKER - ALTECH 1DU2L, 1-POLE, 2A (EBR-147)
- 39 - CIRCUIT BREAKER - ALTECH 1DU3L, 1-POLE, 3A (EBR-163)
- 40 -
- 41 -
- 42 -
- 43 -
- 44 - CIRCUIT BREAKER - ALTECH 1DU15L, 1-POLE, 15A (EBR-146)
- 45 -

ELECTRICAL SYSTEM CHARACTERISTICS					
VOLTAGE:	230 VAC	PHASE:	1Ø	FREQUENCY:	50 Hz
AMPERAGE DRAW (MAX)					
MODEL #	CORD#1	CORD#2	N/A	RLA / MCA	
CU-41L5	8.8 A	N/A	N/A	8.8/11.0 A	
- PROVIDE THHN STRANDED COPPER CONDUCTORS W/ A TEMPERATURE RATING OF 90°C (194°F).					

PERCIVAL SCIENTIFIC, INC.	
TITLE:	ELECTRICAL SCHEMATIC - GENERAL
MODEL:	CU-41L5
BY:	RAS
DATE:	12/15/25
DRAWING:	036171-0-1

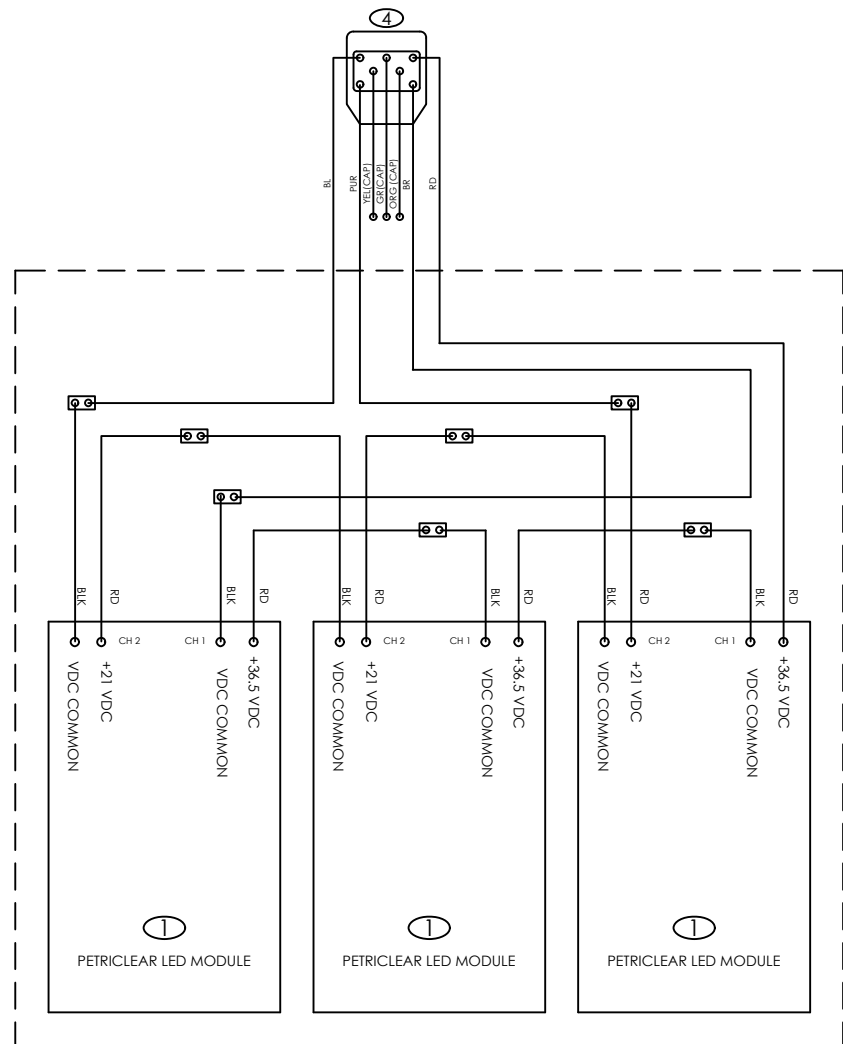
REFER TO MAIN CHAMBER
ELECTRICAL SCHEMATIC:



- 1 - LED MODULE - PETRICLEAR LED TILE, WHITE / INFRARED (ELD-143A)
2 - LED DRIVER - XLG-75-L-AB, CONSTANT CURRENT (ELD-120)
3- LED DRIVER - HLG-60H-C350B, CONSTANT CURRENT (ELD-130)
4- PLUG - EMF #P-7-1, 7-PIN, 7-COLOR (EPL-052)
5 - RECEPTACLE - EMF #R-7-1, 7-COLOR 108" WIRE LENGTH (ERE-083)
6- DALI CONVERTER - 100-240 VAC, DALI INPUT, 10V PWM OUTPUT (ELD-049)

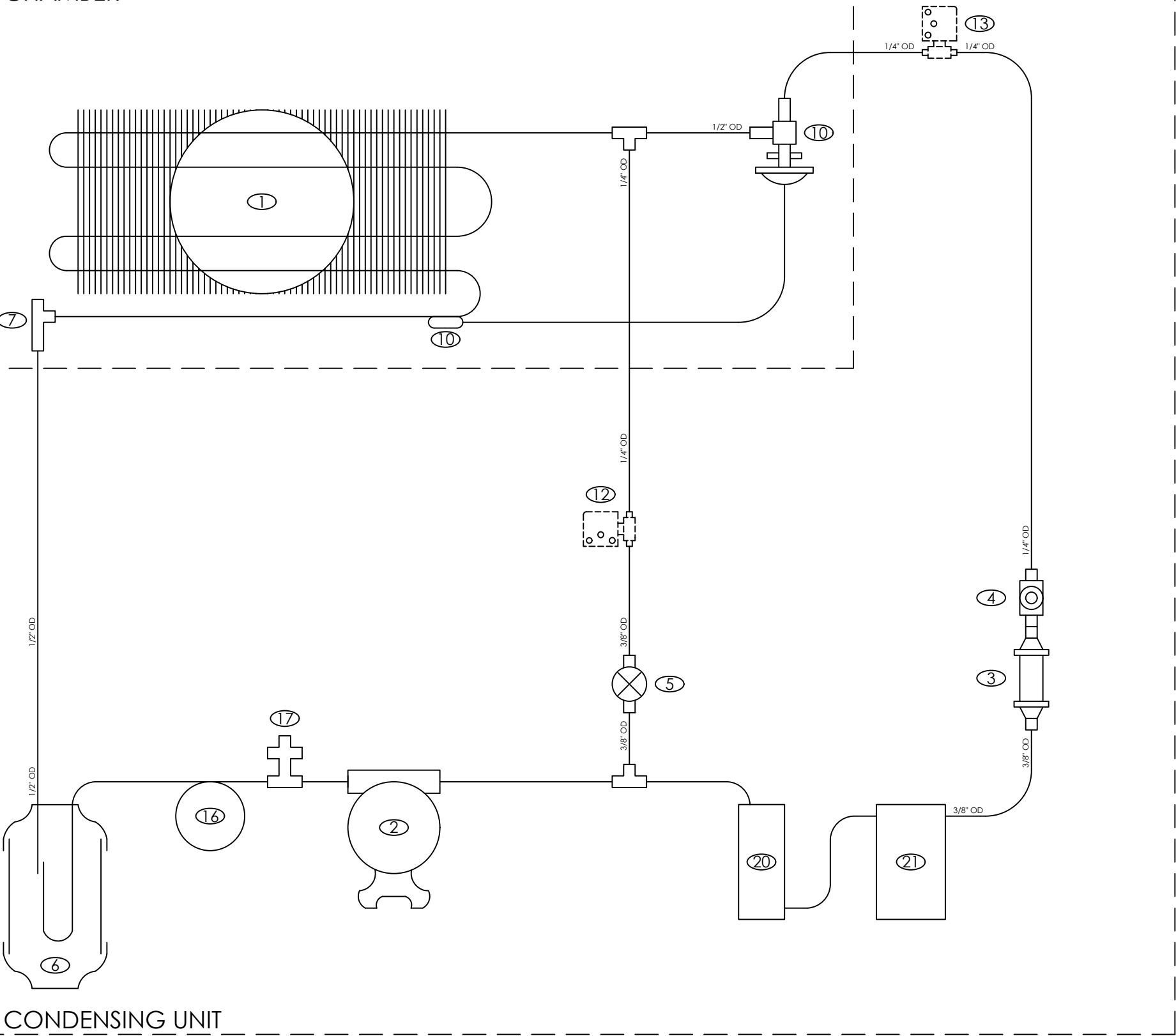
- NOTES
1. CORD LENGTH TO BE 18".
2. CAP DIMMING WIRES ON ELD-120.

AMP DRAWS:	AT 40 VDC	AT 21 VDC	AT 120 VAC	AT 220 VAC
AMP DRAW PER TILE:	0.35 A	0.67 A	CH 1	CH 2
AMP DRAW PER LAMPBANK:	1.05 A	2.01 A	0.35A	0.35A
			0.19A	0.19A



PERCIVAL SCIENTIFIC, INC.			
TITLE:	ELECTRICAL SCHEMATIC - LIGHTING		
MODEL:	CU41L5	DRAWING:	REV:
BY:	RAS	DATE:	12/15/25
		036171-0-2	-

CHAMBER



CONDENSING UNIT

- 1 - EVAPORATOR COIL - THREE FANS,TA-23SG, 230 BTU/°FTD (RCO-084)
- 2 - COMPRESSOR - 1/2 HP, R-513A, COPELAND M7ZH-0045-IAZ-328 (RCU-313)
- 3 - DRIER - SPORLAN C-052-S, 1/3 TON (RDR-008)
- 4 - SIGHT GLASS - SPORLAN SA-12S, 1/4" ODF (RLI-001)
- 5 - HAND VALVE - MUELLER A-14850C, 3/8" ODF (RVH-002)
- 6 - SUCTION ACCUMULATOR - REFRIGERATION RESEARCH #3701, 5/8" ODF (RAC-002)
- 7 - CRANKCASE PRESSURE REGULATOR - SPORLAN CRO(T)-6, 5/8" ODF, SET AT 45 PSI (RPR-001)
- 8 -
- 9 -
- 10 - EXPANSION VALVE - SPORLAN Q, 1/4" IN X 1/2" OUT SAE, 1/2 TON (RVQ-001, -102, -200)
- 11 -
- 12 - SOLENOID VALVE - SPORLAN, HOT GAS LINE, OPEN ON TEMPERATURE FALL (RVS-027, -028, -031)
- 13 - SOLENOID VALVE - SPORLAN, LIQUID LINE, OPEN ON TEMPERATURE RISE (RVS-027, -028, -030)
- 14 -
- 15 -
- 16 - VIBRATION ABSORBER LOOP - (NO PART NUMBER)
- 17 - SERVICE VALVE - PART OF M7ZH-0045-IAZ-328 (RCU-313)
- 18 -
- 19 -
- 20 - CONDENSER - AIR COOLED, PART OF M7ZH-0045-IAZ-328 (RCU-313)
- 21 - RECEIVER - 90% PUMPDOWN FOR R-513A OF 2.1#, PART OF M7ZH-0045-IAZ-328 (RCU-313)
- 22 -
- 23 -
- 24 -
- 25 -

REFRIGERATION SYSTEM CHARACTERISTICS		
VOLTAGE:	230 VAC	PHASE: 1Ø
FREQUENCY:	50 Hz	
MODEL:	EXP41	REFRIGERANT: R-513A
CHARGE:	33.6 OZ	

REVISION HISTORY		
REV	DESCRIPTION	BY / DATE
A	INITIAL VERSION	TA 06/06/25

 PERCIVAL SCIENTIFIC, INC.			
TITLE: REFRIGERATION DIAGRAM - GENERAL			
MODEL:	EXP41	DRAWING:	REV:
BY: TA	DATE: 06/06/25	2025-5-1-1	A

