ElectricBrewing
SUPPLY

Wiring Guide Book

ElectricBrewing
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Dear Home brewer,

Thank you for purchasing our DIY electric home brew control panel kit. It is our intentions that these kits help you along in your goal of building your dream brewery. Each package includes hardware, a drawing, and our short how-to, to help you along your way. If at any time you have any questions, please contact us via support@ebrewsupply.com or through our website.

We greatly appreciate your support and hope you find success with our help.

Thanks,

Ryan and Katie Gray
Electric Brewing Supply, LLC

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Do not attempt to build this panel if you have no experience with electrical or wiring. It is also highly recommended that you have a qualified electrician look over your work if you are unsure or have any doubts. These instructions are based on working designs, and are provided as guidance. It is, however, left to you as the builder to insure that adequate steps are taken to insure proper, safe operation.

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Table of Contents

You have purchased one of our

DIY kits, now what do you do?

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First, check off that you have everything that you need to build a complete panel.

Each kit will ship with a list of included hardware.

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The Hardware and Tools

DIY Basic kit versus DIY Complete kit

Depending on the kits you chose to purchase, your included list of hardware will be a complete list or will require to source additional hardware. The Basic kits allow you more flexibility in your design, but will also require you take more time to source the balance of parts needed versus the complete kits.

For complete kits, you may also have a few steps you can skip as you build, again depending on the variation you choose. While the basic complete kits include enclosures, you will still need to drill and cut; versus the upgraded DIY complete kits where the enclosure will come pre-drilled, cut, and tapped.

Basic Differences between Basic DIY and Complete Kits

	Basic DIY	Complete Kits
Includes LEDs	Yes	Yes
Includes Switches	Yes	Yes
Includes Contactors	Yes	Yes
Includes Relays	Yes	Yes
Includes External Heat Sink	Upgradeable	Yes
Includes Enclosure		Yes
Pre-Cut Enclosure Options		Upgradeable
Includes Outlets		Yes
Includes Temp Controllers		Yes
Includes Temp Probes		Yes
Includes XLR Inlets		Yes
Includes Wiring		Yes
Includes Elements	No	No

Basic Kit Additional hardware

If you purchased a DIY Basic kit you may also need the following, or some variation thereof.

1. An Enclosure
2. (2) L5-15 type outlet and plugs for up to 2 pumps
3. (2) L6-30 type outlet and plugs for up to 2 elements
4. (1) L14-30 type inlet and connector for 30a power supply,
    a. Recommend CS6364C connector and CS6375 type inlet for 50a or a cord grip for 6/4 SJOOW cable as an alternative.
5. (6) feet of 6ga wire for 50a panel, 10ga for 30a panel for inside
6. (16) feet of 10ga wire for element wiring
7. (30) feet of red 14ga wire
8. (25) feet of white 14ga wire
9. (40) feet of red/black 16-20ga wire for low 5v/SSR circuit
   * If you can, we frequently use multiple colors for reflecting elements, pumps, etc. and their specific control and LED circuits. For example, we use 16 feet of yellow and orange, cut into two 4 foot and one 8 foot lengths, 4 from the BCS to the switch, 4 from switch to SSR, and 8 for the loop across the 2 legs of the elements 10ga wire. Additionally, we use 8 foot cuts of blue and purple for the pumps BCS signals. *** PID design would exclude the pumps, and first 4 foot cut.
10. (15) feet of white 16-20ga wire for low 5v/SSR circuit
11. (20) feet of 10/3 SJOOW Electric cord for elements
12. (10) feet of 10/4 SJOOW (for 30a) or 6/4 SJOOW (for 50a) for power supply plug --- this could be replaced with a 6 ft range power cable which already has a 14-30 or 14-50 plug molded on one end.
13. Hardware to secure din to plate and mount completed panel to wall

Temperature Controllers

Most important to any build is a means to control temperature. For BCS configurations you will need either the BCS-460 or BCS-462. Whereas for PID, you will have a few options, but we recommend sticking with known brands such as Love and Auber. In your schematics you will find the Auber SYL-2352 pins.

Tools you will need

1. A good pair of wire cutters, you'll be using them a bit
2. A good pair of wire strippers are highly recommended as you'll be using them quite a bit.
3. Flat and Phillips head screw drivers
   *While both are needed or used, a good ¼" flat will go a long way.
4. 7/8" hole saw drill bit or step bit for LEDs and switches holes
5. Drill with a good bit for pilot holes, usually 1/8" is adequate
6. Rotary tool and/or angle grinder for cutting large square holes
7. Using our flanged twist lock outlets/inlets then you will also need:
   a. 2-1/8" hole saw for L6-30 outlets
   b. 1-1/2" hole saw for L5-15 outlet
   c. 2-1/4" hole saw for L14-30 outlet
   d. For easy mounting, an 8-32NC Drill/tap bit for drilling and taping holes for the screws.
8. For XLR inputs, 3/4" hole saw and a smaller screw such as a 3mm screw.
9. Soldering iron if you use XLRs
10. Masking tape and Sharpie marker
11. Speed Square
12. Tape measure (metric is best)

What do we recommend for tools

In building control panels, we burn through a number of bits, taps, blades etc. as such we come to rely on some, and throw out the rest. On those marks, we usually aim for a few key factors before sticking with something, those being price, readily available from many sources, and hold up longer than one use. For drill bits we stick with name brand but at the small 1/8, 9/32 sizes, most are adequate; at 1/4 and up the split point from DeWalt have proven to work well. For holes saws and taps we stick with Greenlee products such as the Greenlee DTAPM4C, DTAPM3C, and the DTAP8-32 for taps, and 645 series quick change hole saws. These pieces aren't the cheapest or the most expensive available, but are reliable for everyday use and certainly reliable for a large project such as this.

Please be patient, it will take some time to build your panel.

Plan on a long weekend or two if you can.

Laying out a panel door

First step in the process is to design your panel: Plan first, cut last. There are many ways you can lay out your panel, but knowing what the indicators and switches are intended to convey will help you determine the best layout for your own.

LEDs

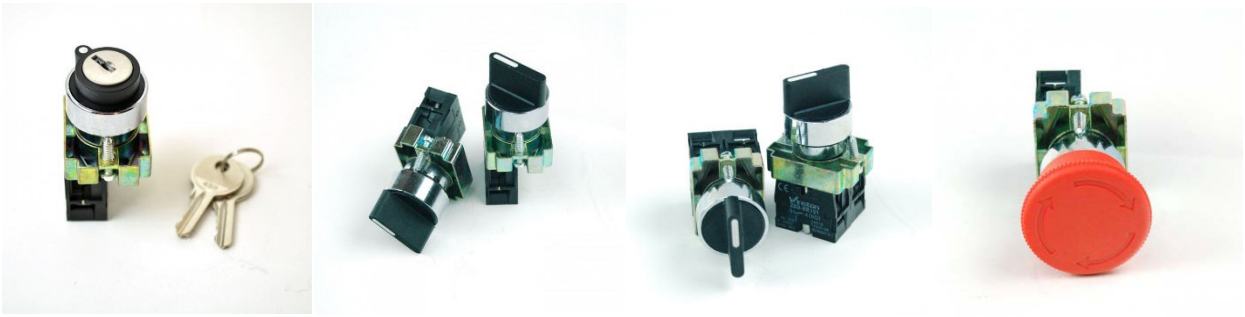
BCS Specific

- 110v White LEDs indicate BCS control assigned for pumps

BCS and PID Control Panels

- 220v White LEDs indicate that the Element is actively on
- 110v Yellow LEDs indicate that the element contactors are on
- 110v Blue LEDs indicate that the pumps are in manual control and are on
- 110v Red LED indicates that the system's e-stop switch has been pressed and locked
- 220v Green LED indicates that the control panel is on and power is coming in

Switches



Each design ships with a number of switches, PID or BCS specific, and not specific. Each kit includes a key switch, intended for the main power so that a panel can be locked from use. Additionally, they each come with a mushroom, maintained, twist to unlock, button; otherwise referred to as the e-stop. This estop is intended to halt any process(es) that may be occurring while brewing without completely disrupting or shutting down everything. This allows the user to react to a problem by simply pressing the button, correcting, and continuing.

BCS Panel Specifics

3-way switches are used throughout the front of the BCS panel to allow an Auto (or BCS controlled) function with manual over-ride. This comes in handy with the pumps when one needs to be primed to start. By having auto for the pumps, the user can take advantage of remote control via the web interface to allow for automated steps or starts.

For the 30a control panel the 3 way selection refers to [BCS (Auto) – Off – On] for pumps only; for elements the switch selects between element contactors [Boil – Off – HLT] (or vice versa).

For the 50a control panel the 3-way selection refers to [BCS (Auto) – Off – On] for both the pumps and elements.

For completes, also included is a green push button intended to be an Input button for easy process exit conditions, and 2-way switch for on-off control of the buzzer alarm LED, again for easy temporary silencing.

PID Panel Specifics

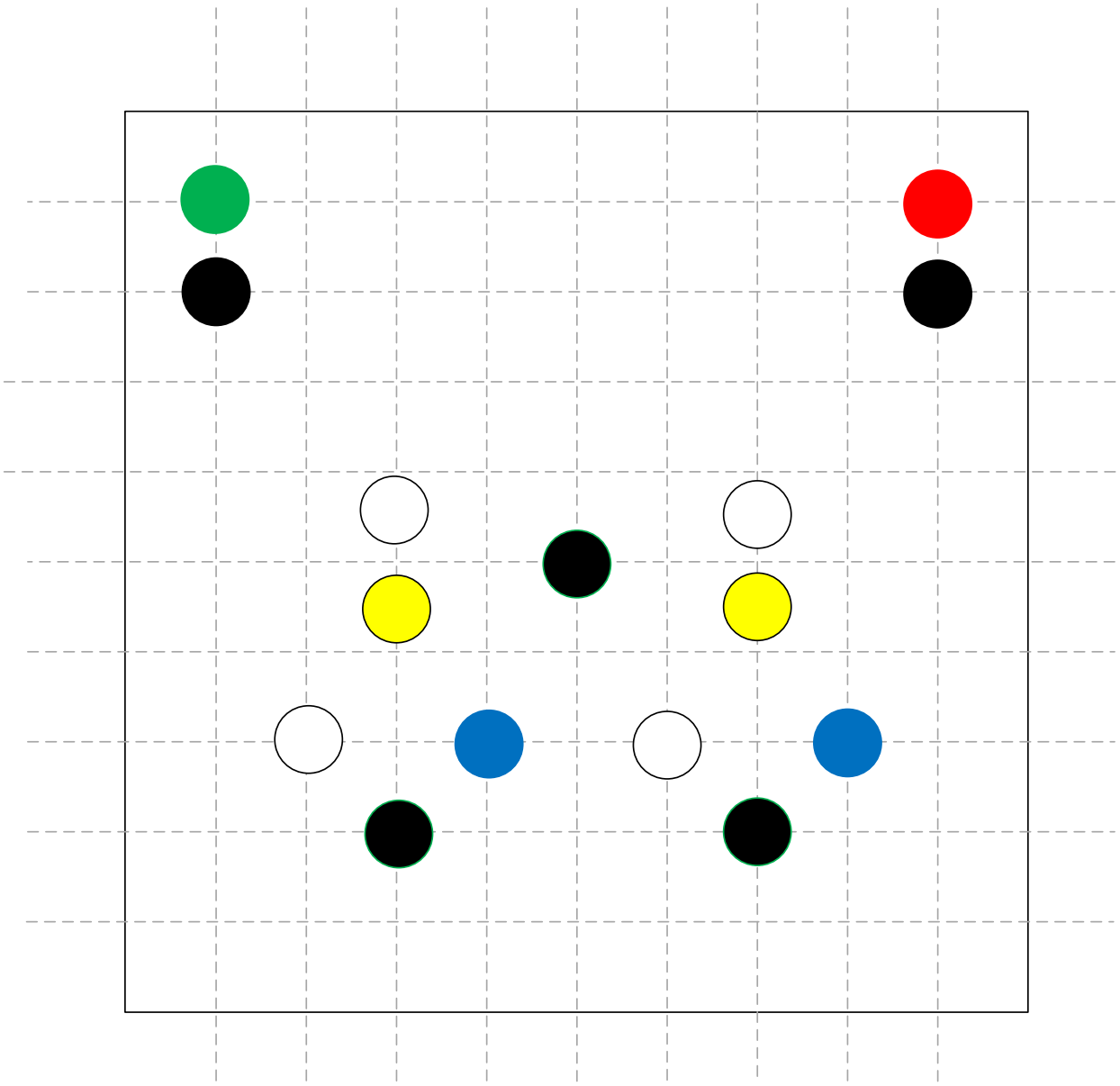
Because of the simpler aspects of the PID setups, there are more 2-way switches than 3. This is because unlike the BCS, much of the PID control panel is intended for direct user control.

For the 30a control panel the 3 way selection for elements, selects between elements [Boil – Off – HLT] (or vice versa). Otherwise, each 2-way switch is intended for either a pump, an element contactor or an alarm. To make you wiring and layout go smoother, we recommend using only

one 2-way switch and daisy connecting each of the alarm outputs of your PIDs and timer to this switch. The additional switches are available for those who prefer individual switches for alarm outputs.

Designing the Layout

While we build our panels using a consistent layout with our enclosures, this may not be your preferred approach. The following are our layout designs for BCS as well as PID:

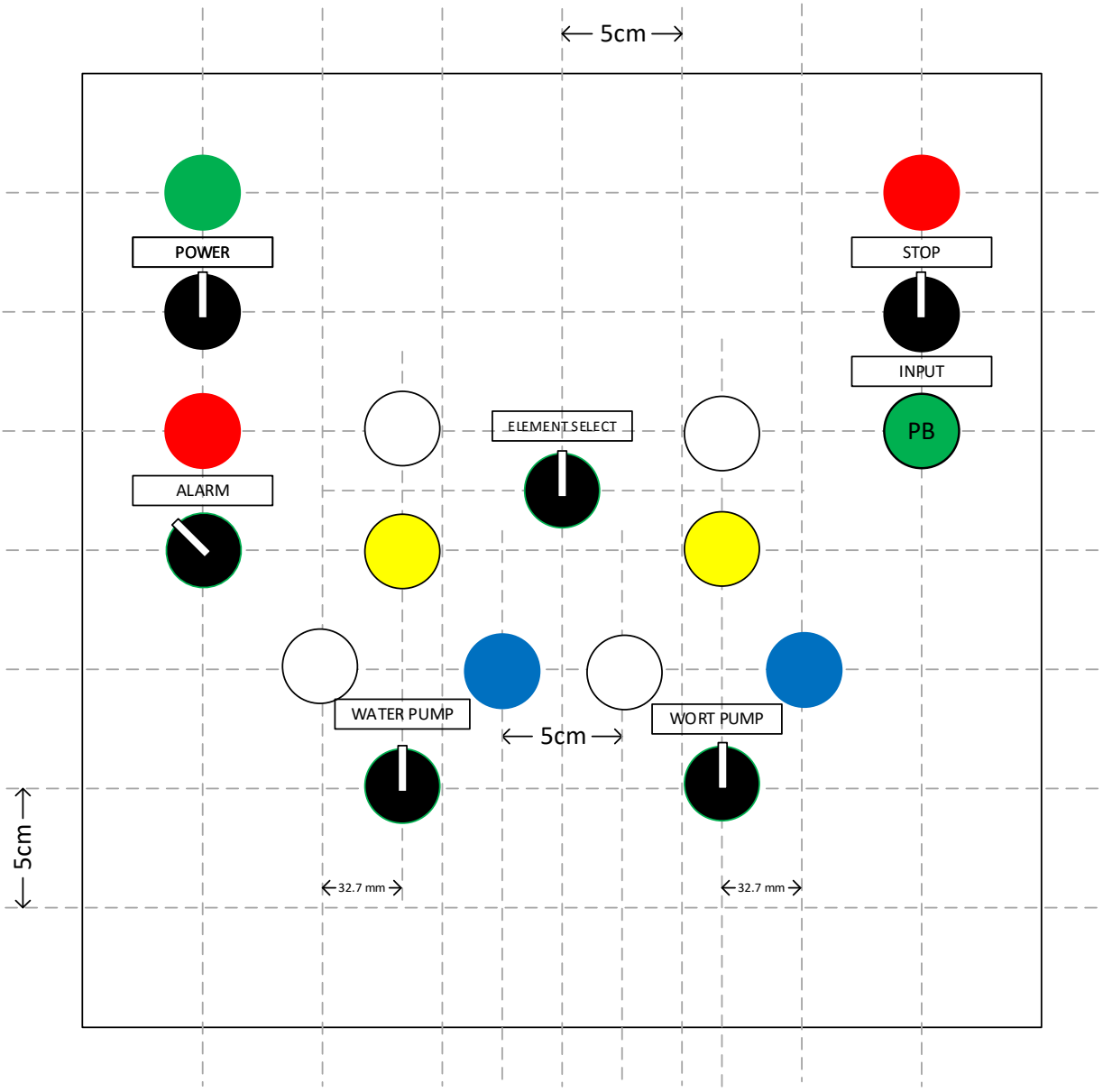


Scale = 40mm or approx. 1-1/2 inch

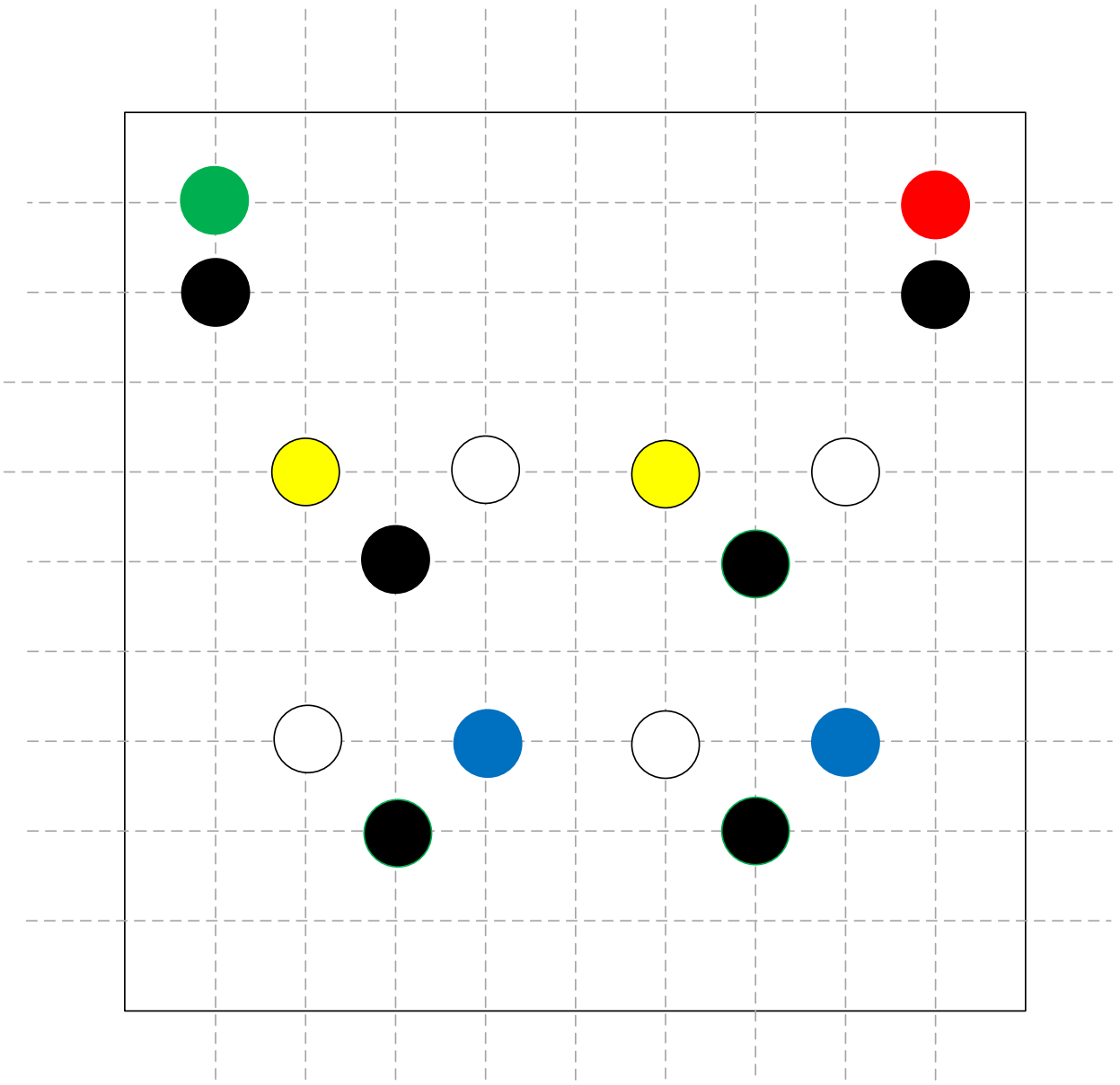
30a BCS Basic DIY Panel Layout

Our Assembled panel layout

The following is the usual layout used for panels built. The metric measurement is easiest due to the import factor, with dimensions of 400mm x 400mm for the door. The grid below is broken into 50mm increments.



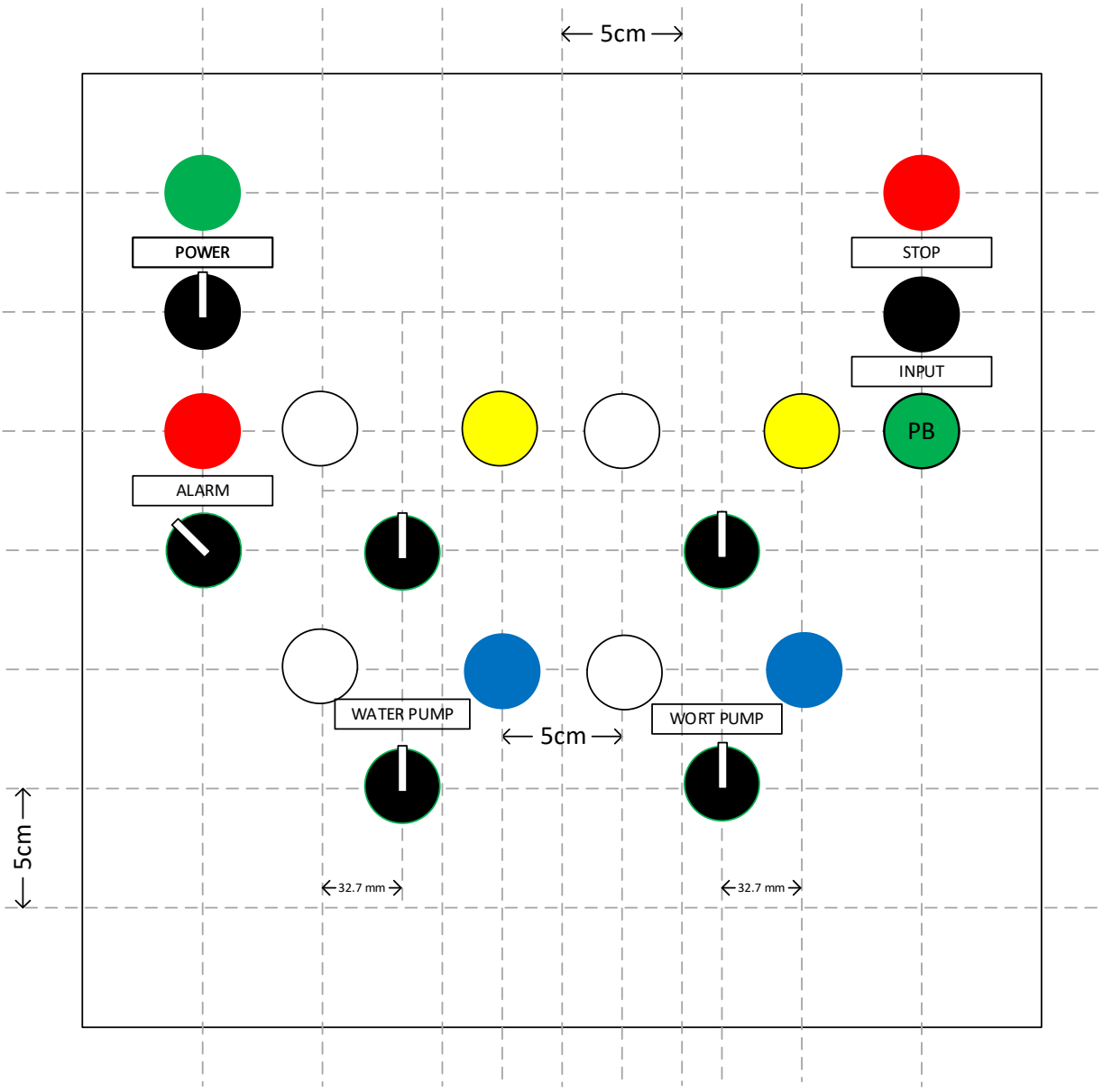
30a BCS Complete Panel Layout



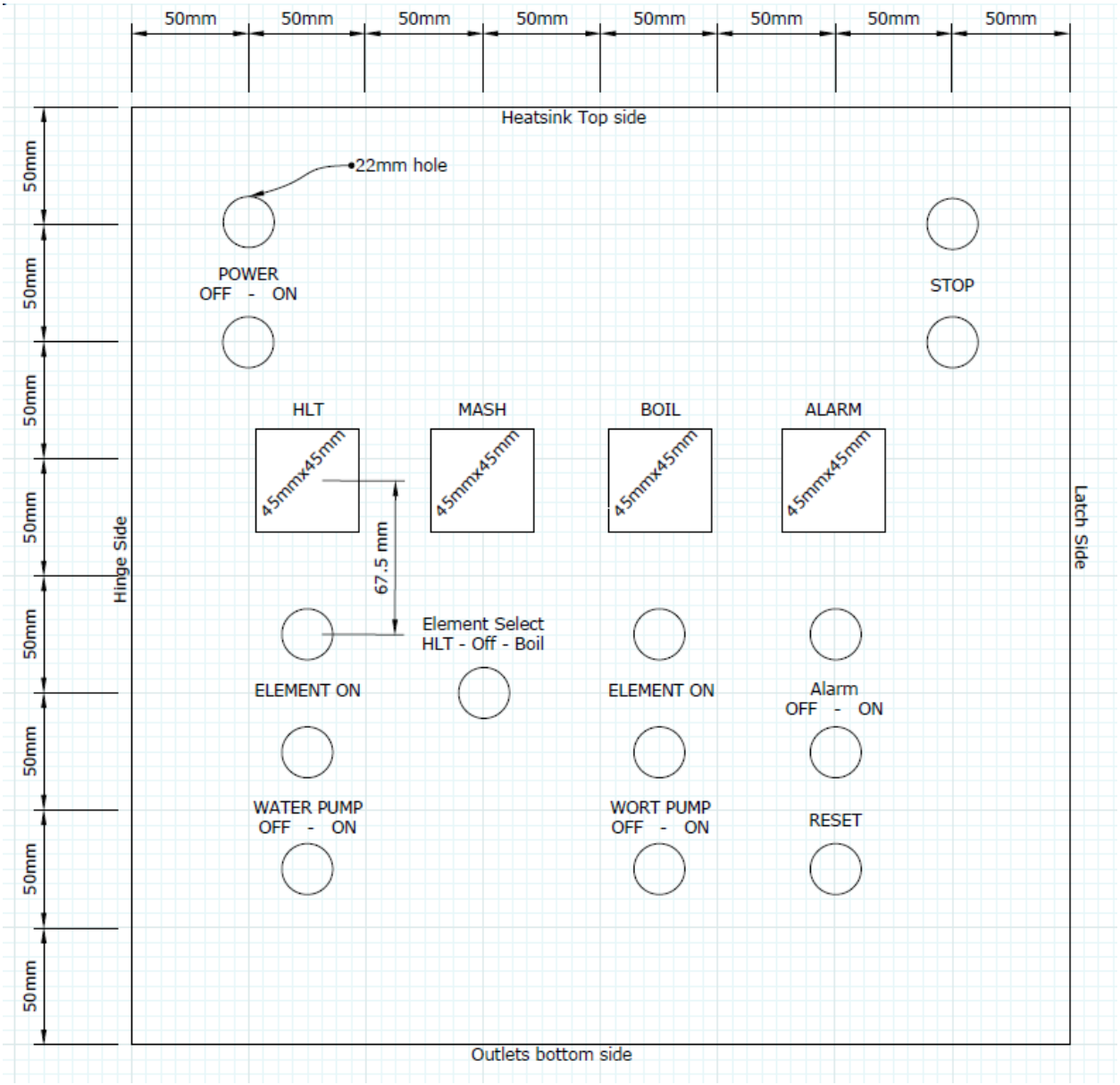
50a BCS Basic DIY Panel Layout

Alternative layout

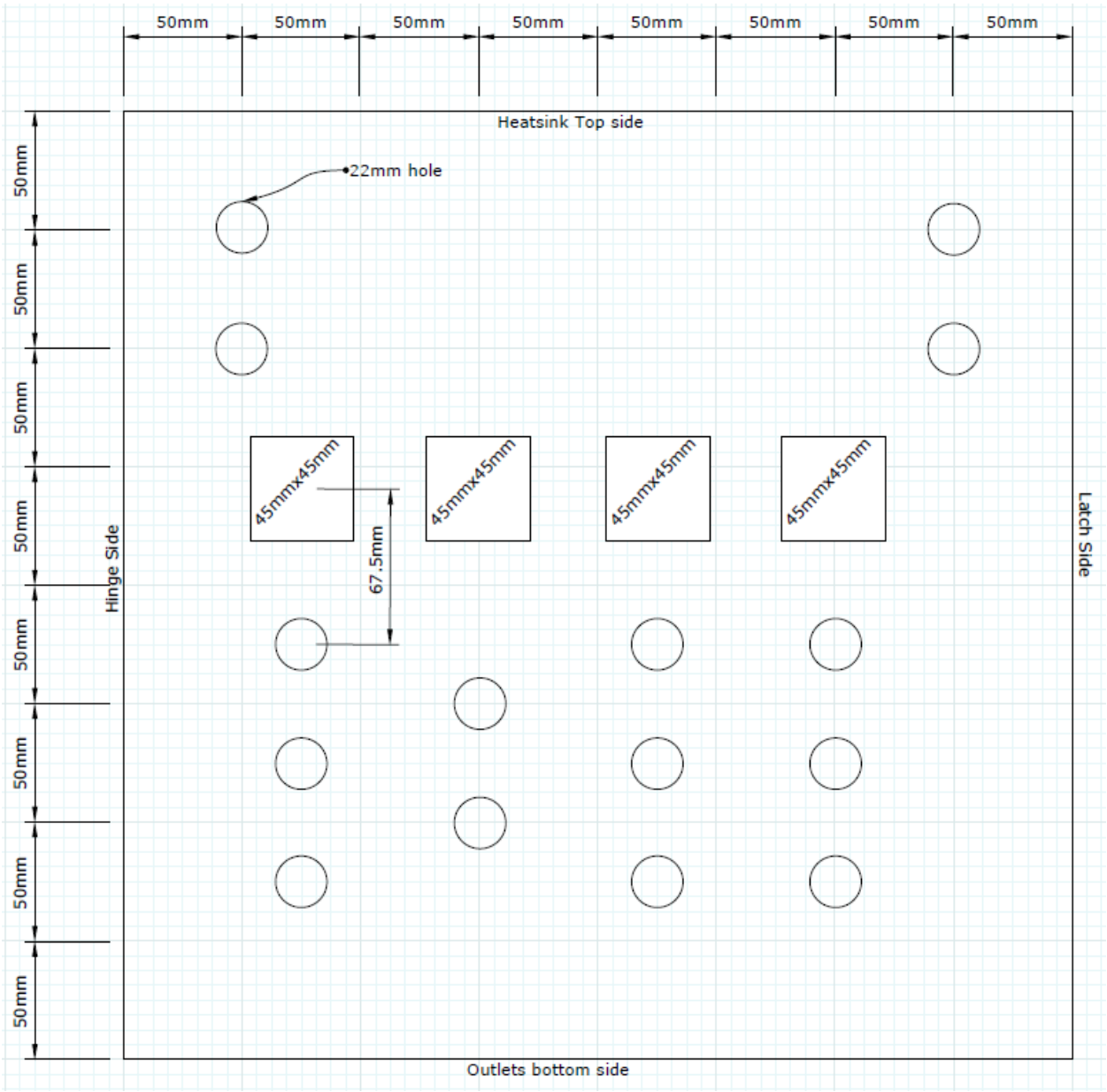
The following is the usual layout used for panels built. The metric measurement is easiest due to the import factor, with dimensions of 400mm x 400mm for the door. The grid below is broken into 50mm increments.



50a BCS Complete DIY Panel Layout



30a PID Panel Layout

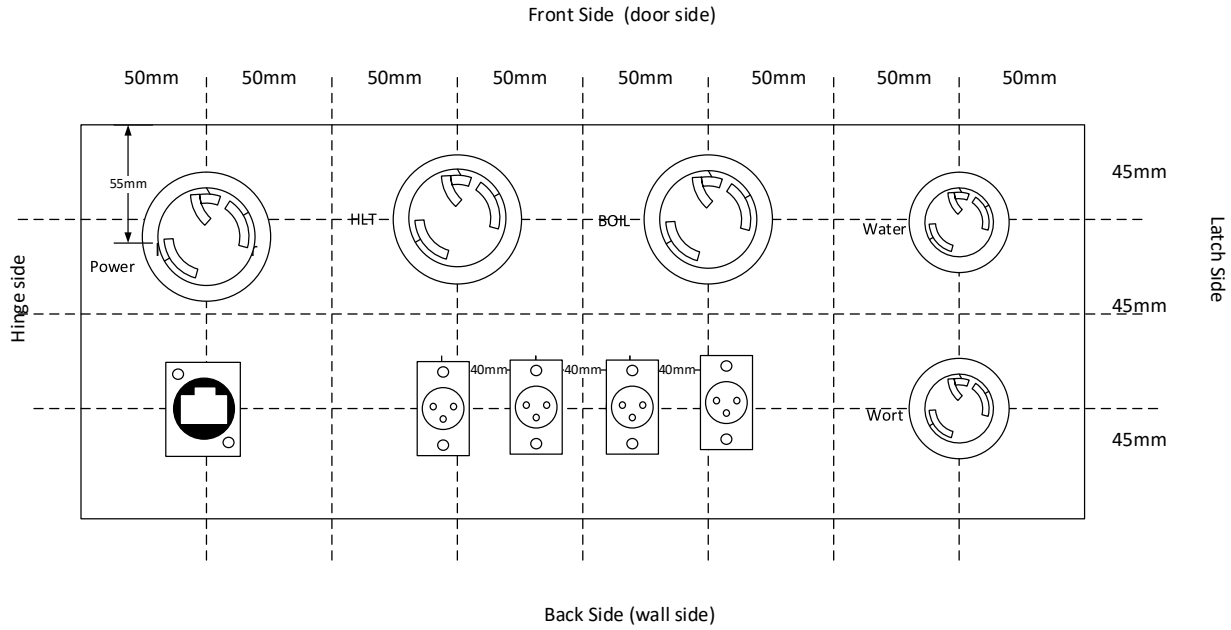


50a PID Panel Layout

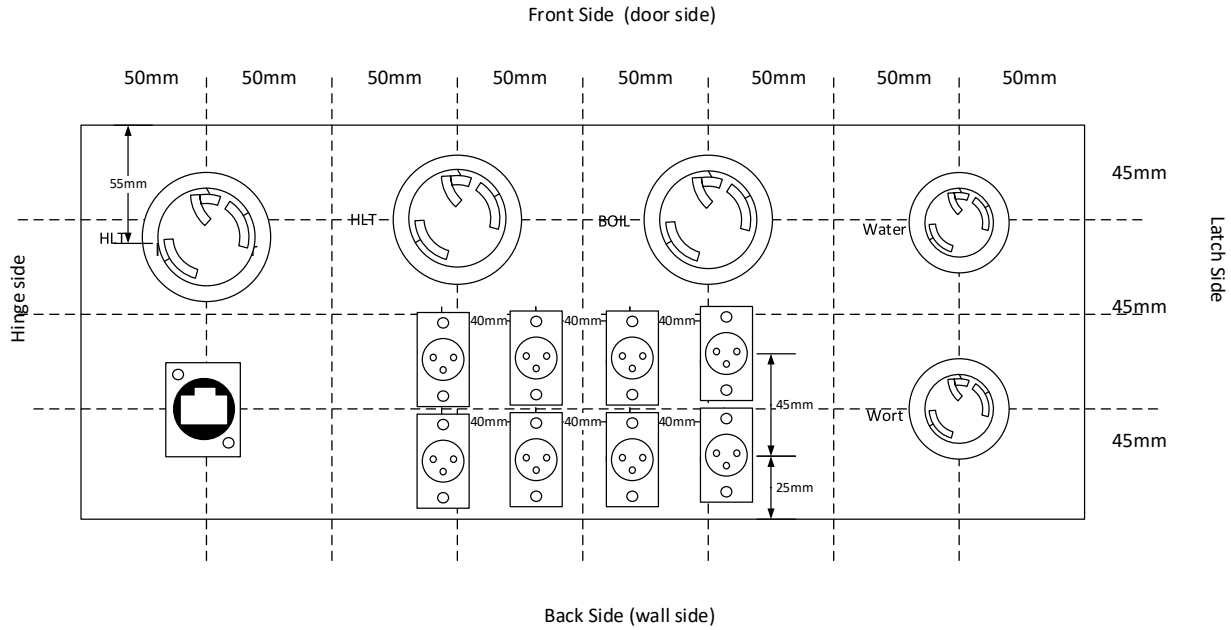
Bottom of Enclosure Layouts

These are tried and tested with success. We have even added more to the bottom of these enclosures; but for most this will cover the design.

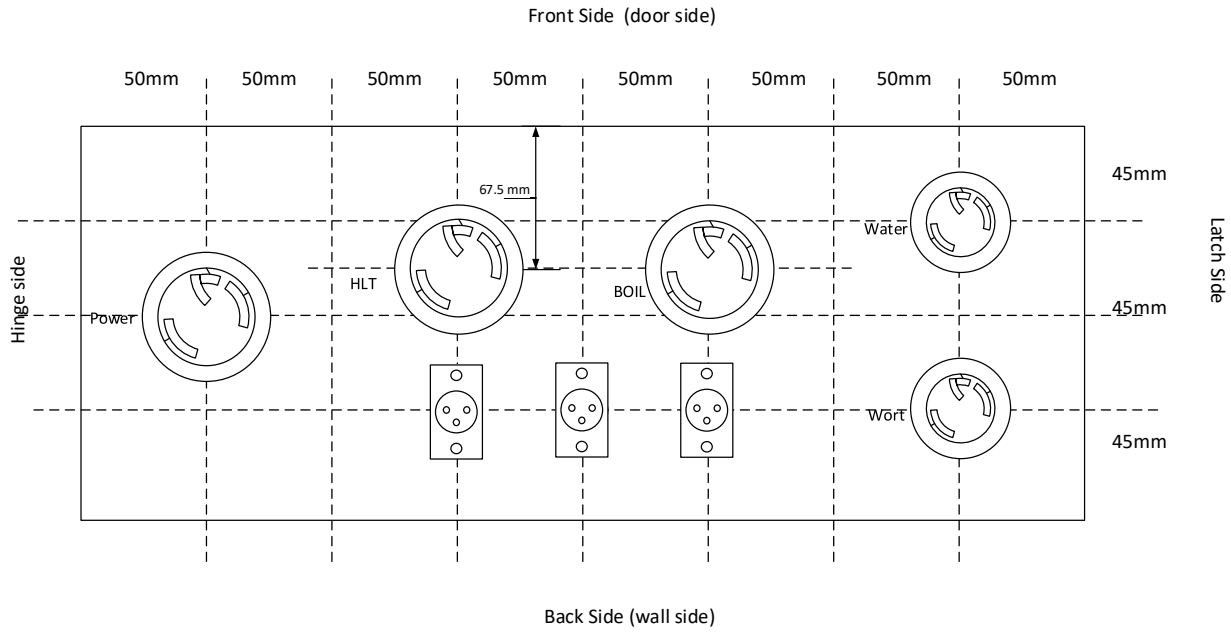
2 element BCS 460 Bottom Layout



2 element BCS 460 Bottom Layout

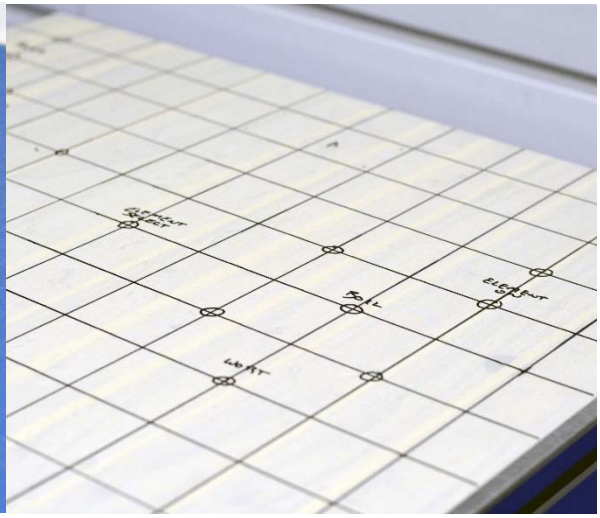


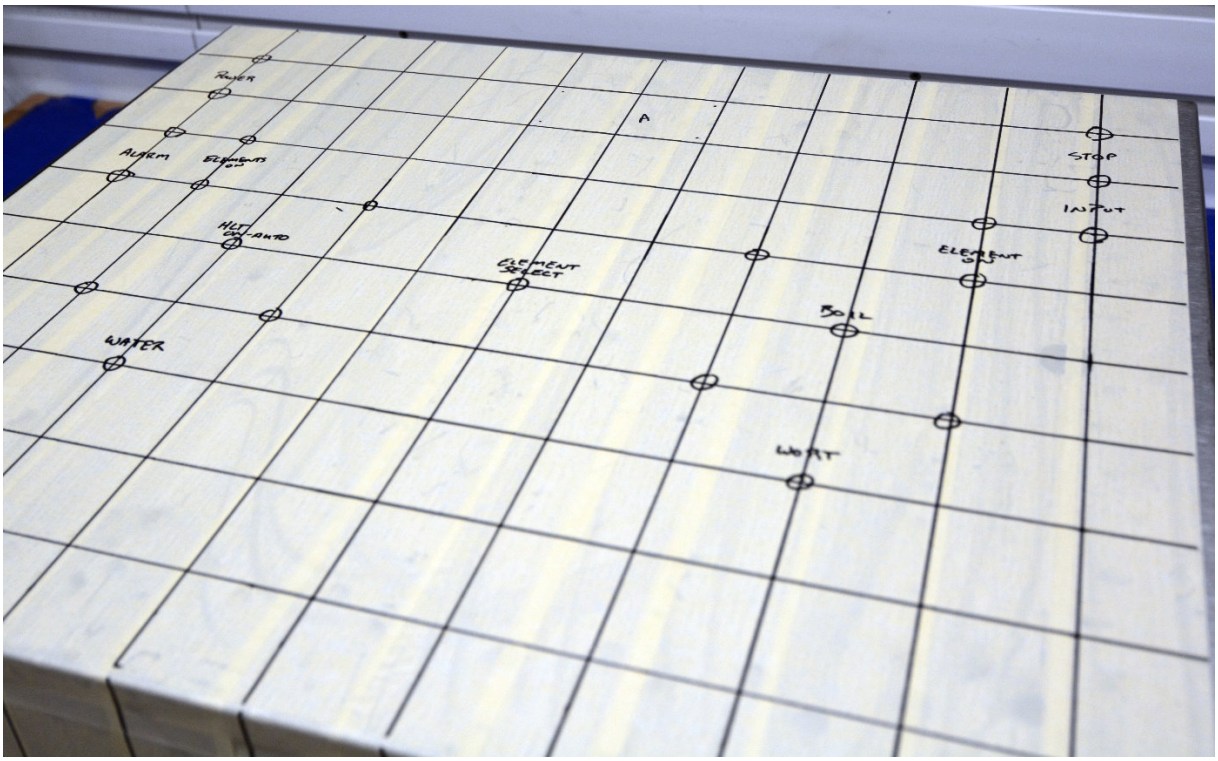
2 element PID Panel bottom layout



Laying out and cutting the holes

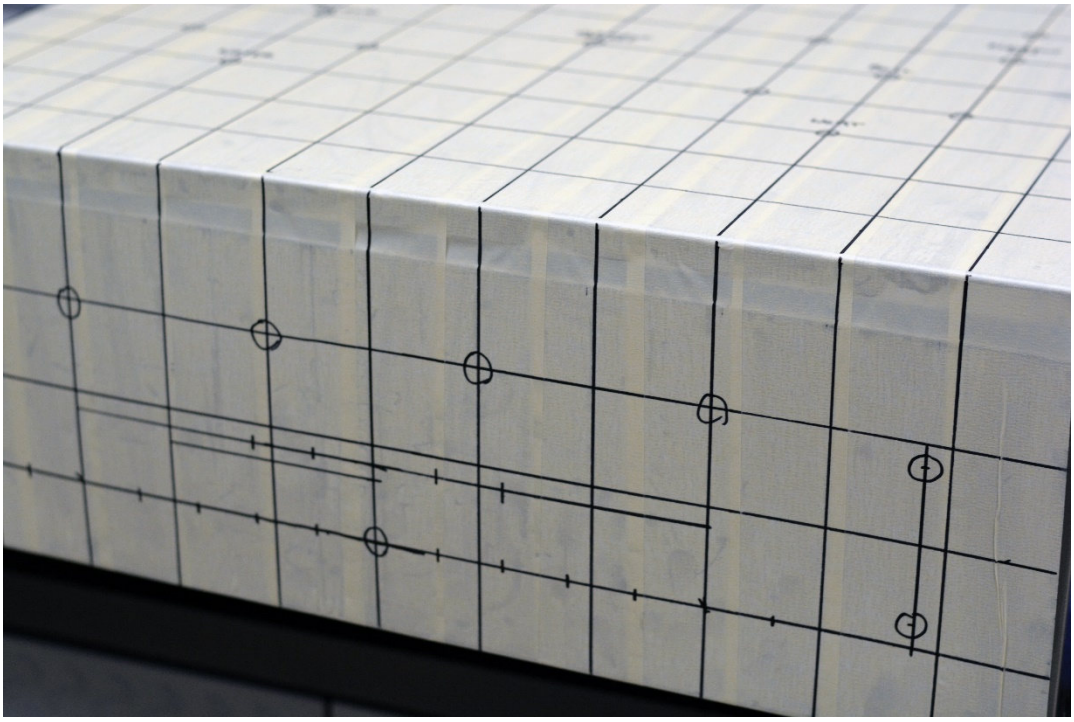
To cut the holes for your panel, you will need: Painters tape, a Sharpie marker, tape measure, speed square and an idea for your layout.





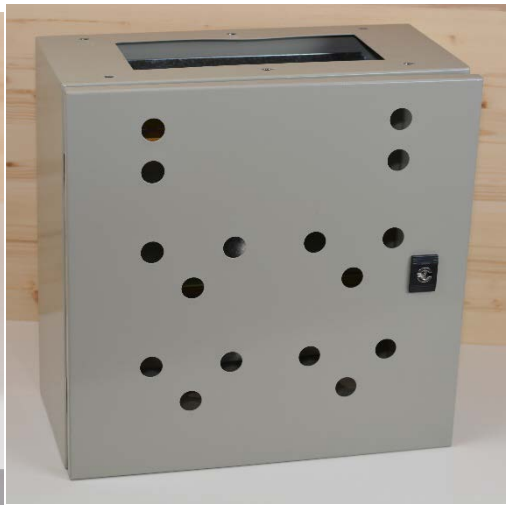
In order to insure that the heat produced, escapes some place, it is highly recommended that you use an external heat sink. Our drilled and pre-tapped heat sinks have standard dimension, and therefore layouts for easy install.

As for the bottom, the following shows our 50a 4-element standard layout. With a grid of 50mm wide by 45mm depth (front to back. The temperature probes are 40mm apart).



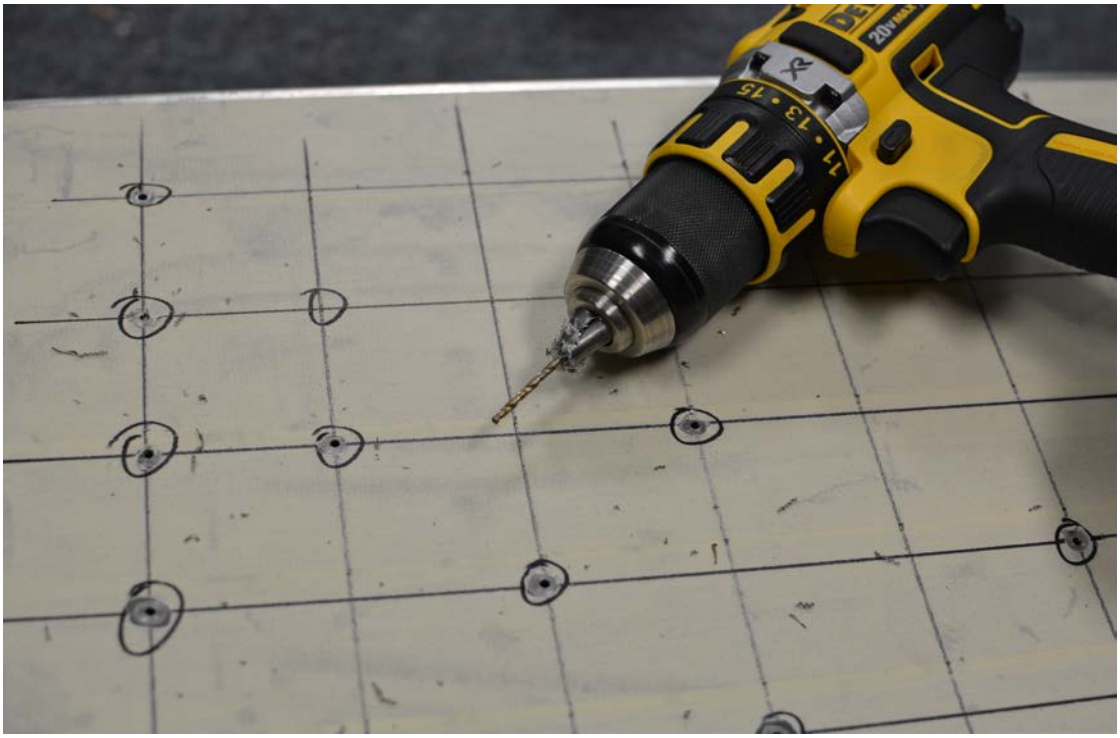
What Size holes are you going to drill?

- For switches a 7/8” hole
- For LEDs a 7/8” hole
- For the XLR Network connector, a 7/8” hole
- For Flanged inlets for 30a and 50a power supplies you will need a 2-1/4”
    - For Green Lee hole saws, you may have trouble finding 2-1/4”, we use 2-1/8” and grind out due to availability problems (discontinued as of 1/1/2014).
- For flanged outlets for elements, a 2-1/8” hole
- For flanged outlets for pumps, a 1-3/4” hole
- For XLR Connections, 3/4" hole

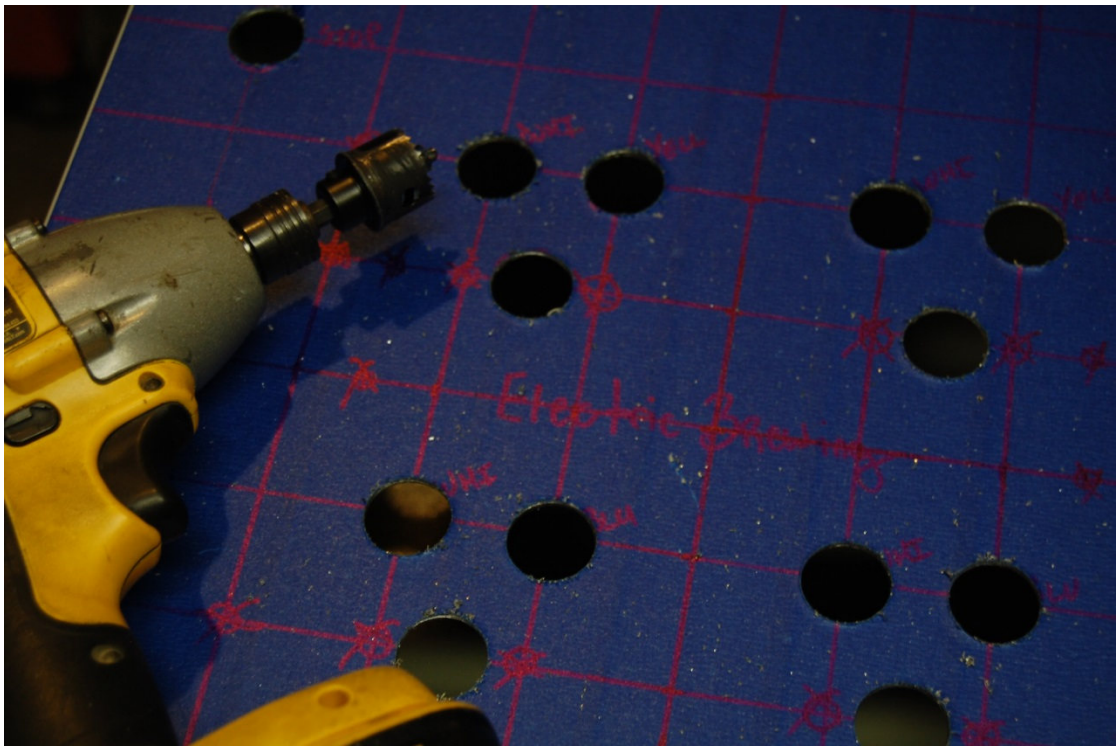


*Layout may differ slightly as we have had a number of minor revisions either by vendors or ourselves.

To insure your drill bit doesn't walk while cutting a hole, use a small bit, 1/8", to create a pilot hole for each larger hole.

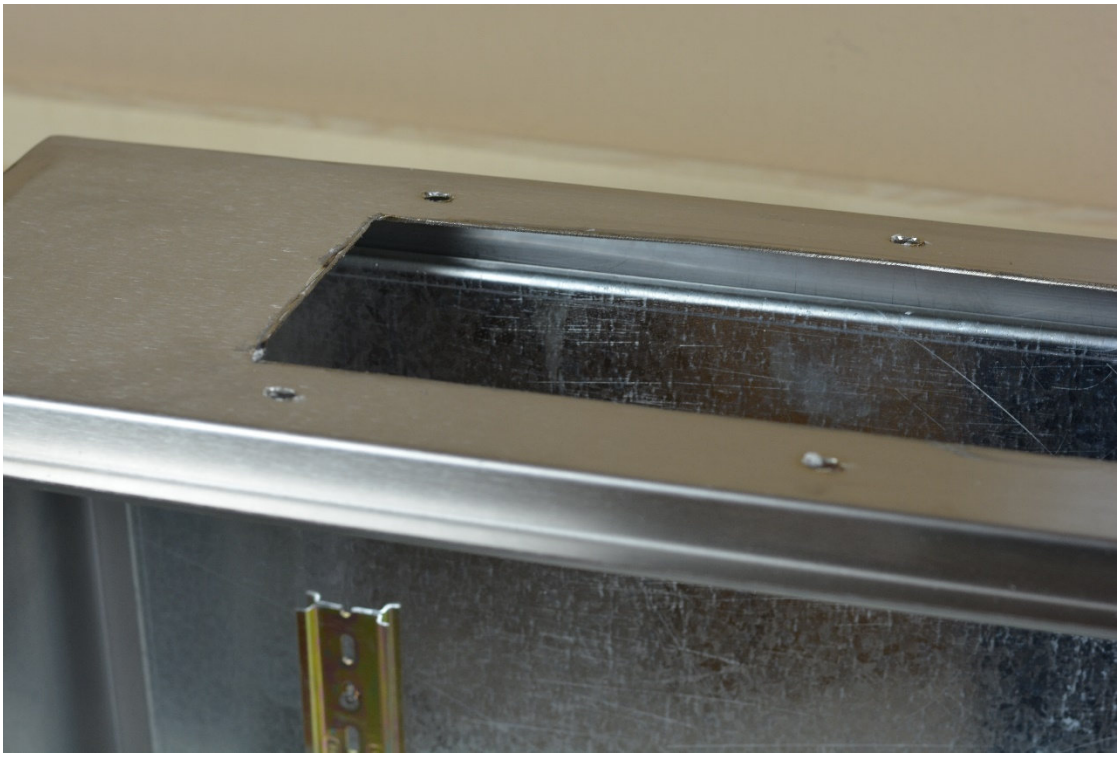


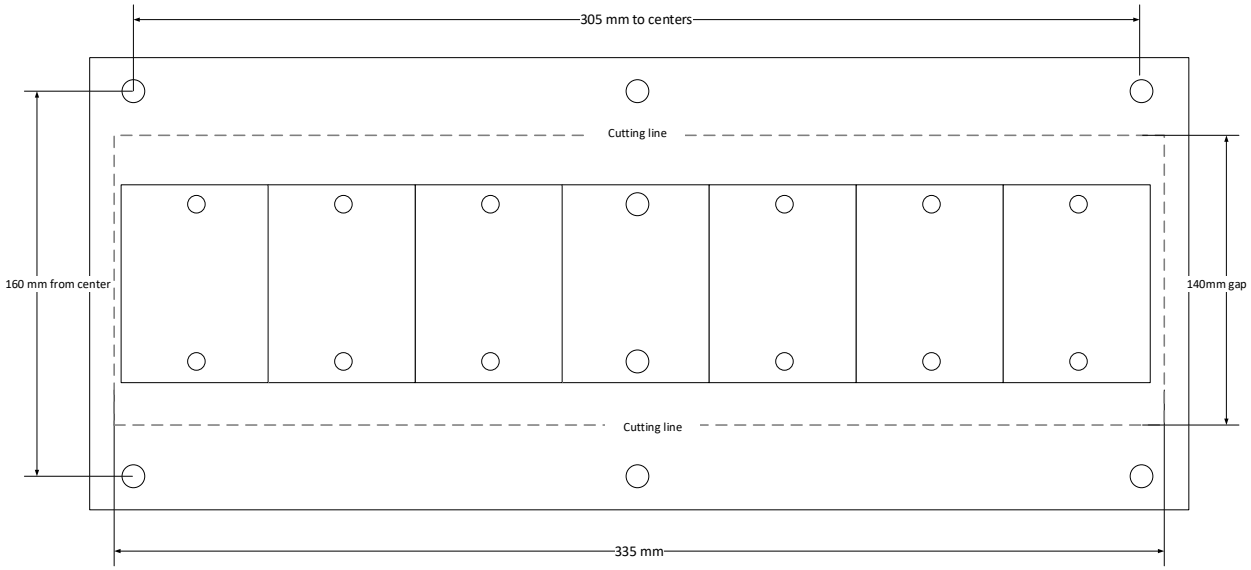
Use your 7/8" hole saw, after drilling the pilot holes.



The Heatsink

To cut the top out, for the quickest results, use an angle grinder. You may also use a rotary tool. It is also important to note that the screw holes for the heat sink are at 0mm, 152.5mm, and 305mm apart running the length of the heat sink, these are then centered, and placed at 20 mm from the back and 160mm from back (for 140mm between front and back screws).





Drawing included with heat sink.

Painting

Once you're done cutting and drilling, do a dry fit of all your hardware to insure it fits properly. If you are satisfied and want to, dis-assemble the enclosure in order to paint it. Painting can hide any scratches or other un-intended mistakes on the original paint. The hinge pins can be removed with a hammer and flat head screw driver, then using the Phillips screw driver and wrench to remove the mount attached to the enclosure. Be sure to go over every inch to be painted with sand paper, otherwise your paint will peel off.

Before you start wiring

It is important to note a few steps in the build process here, as well as a few key design aspects. To keep things as simple as possible, it is generally easiest to work in segments; while this book combines door and enclosure wiring, each aspect can be considered a separate stage. The reason for combining door and enclosure layouts going forward is so that you may see the grand plan as you build.

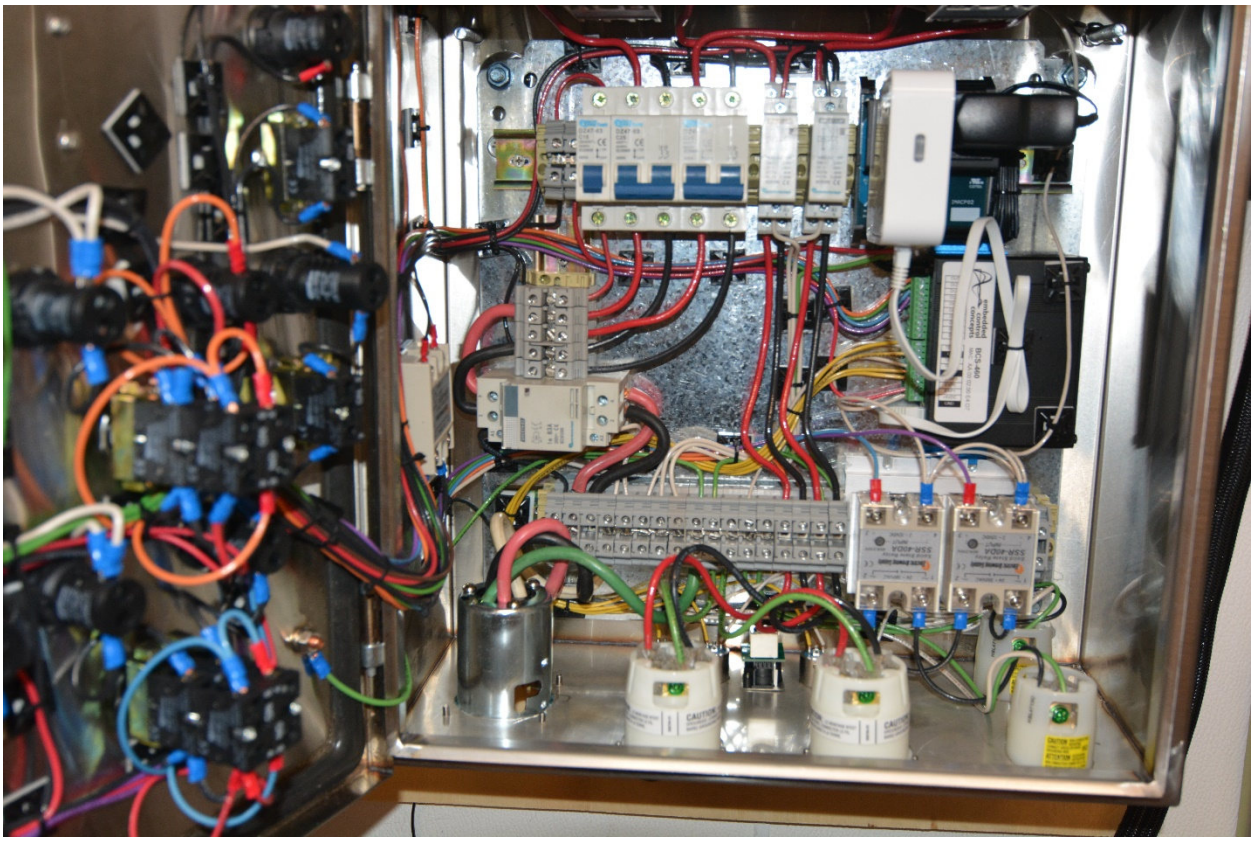
As you begin to wire your panel, you can consider your build in 6 stages:

1. Drill, cut and otherwise prep enclosure. If desired sand and paint it, allow to dry a minimum 24 hours to minimize damage from working on the wiring.
2. Place hardware on the mounting board from the enclosure, but keep the board out of the box. Wire this board as much as possible, it's okay to sacrifice some excess wire later for a cleaner and easier finish later.
3. Wire the door with the common, the 110v, and in case of BCS the 5v+, while it is still detached from the enclosure, this way you're not straining yourself or the door hinge more than necessary.
4. Install the heat sink on the enclosure, and wire it with the low voltage points (+/- input side) wires towards the back of the enclosure. Once these wires are in, install the board, wired. Once the board is bolted down, install the flanged outlets and inlets, XLRs, etc. As mentioned before, a good 3mm and 8-32 drill and tap bits are handy here.
5. Once the outlets are installed, attach the wired door, and wire it up.
6. If all is good to go, test.
    a. It's important to note, that all SSR circuits will still read 120v even in off, this is a natural part of their design. While it will read 120v, the current that flows is just enough to make an LED glow dim, once the element is attached they will go dark.

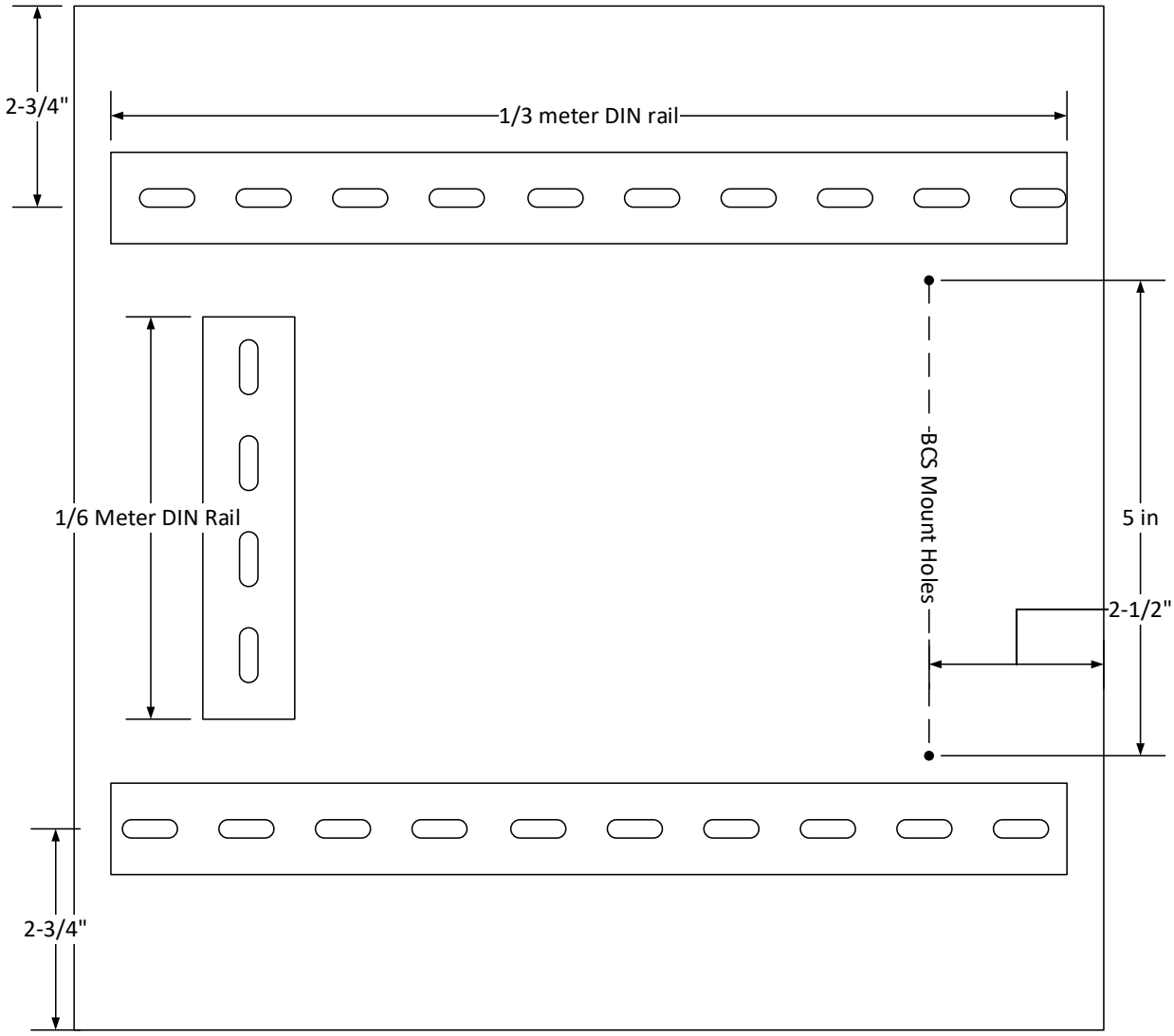
We recommend this process as it should help keep the build more manageable for you.

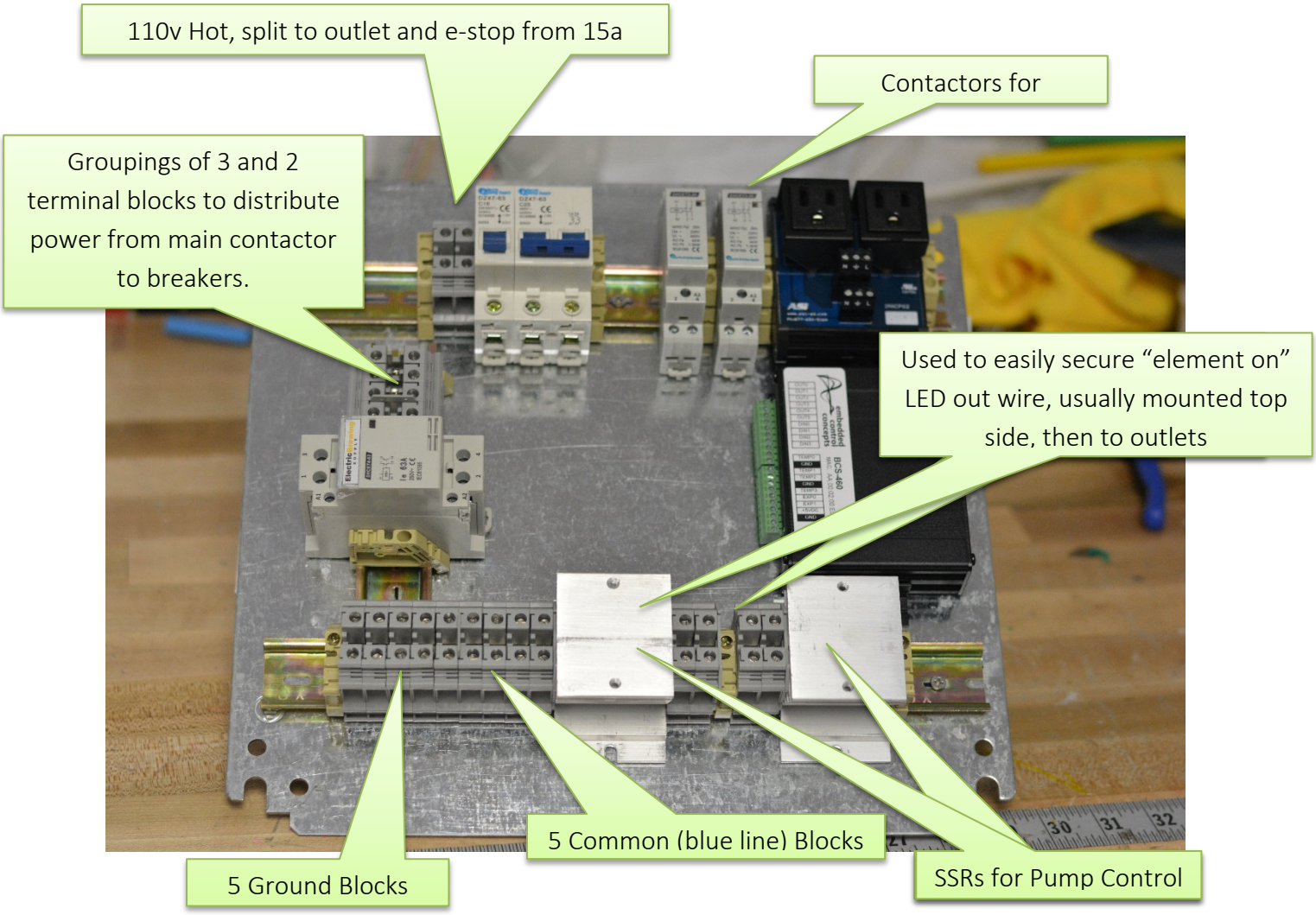
Layout inside wiring

In our builds we use 2 1/3m cuts, plus a smaller 1/6m cut of DIN rail, the package includes 3 cuts in order to allow for more flexibility in your build. You will need to plan your layout before mounting your DIN rail in order to insure you have all the room you need. Once you have a layout, mark it and then using either self-tapping screws or drilling holes and tapping, install your DIN rails on the plate.



This is our standard DIN rail layout, it allows for easy access to most points on the hardware with an open center. We use this for both the BCS and PID layouts.





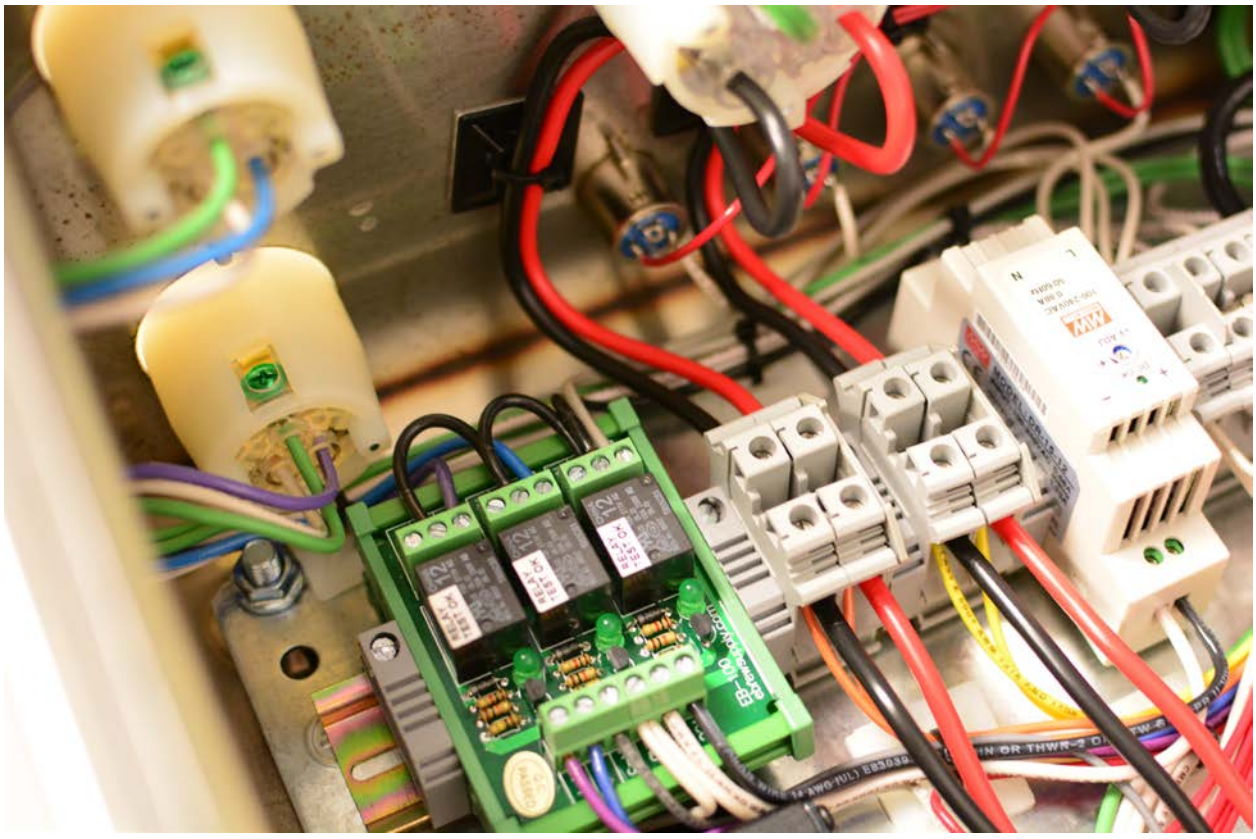
Because of the rigidity of 10ga wire, extra terminal blocks are used to hard wire as much as possible to the enclosure plate before installing the plate into the enclosure. The 2 groupings of 2 terminal blocks on the bottom row act as a solid connection for the LED connections for the 220v element indicators. There are other ways to approach this, but by using the 4 blocks, the wire is secure, and it allows for easier access for wiring the outlets once in the enclosure.

The board layout has (2) 1/3m cuts of DIN rail mounted at 2-3/4 inches from the top of the panel and the bottom. Additionally, the left hand rail is about 1/6th meter (or half of the 1/3m rail) and is mounted 2-3/8 inches from the left. The same goes for the BCS on the right, which is centered between the rails, with 2 screws at 5 inches apart (find center between rails, and measure 2.5 inches from either side).

Layout Updates – Revision August 2015

As a means to provide some additional guidance in line with updates to our own designs, it's best to add to rather than remove dated info. For many years we relied on the SSRs for the alarm and pumps, but through time and practice, new products have been put in action and we find them to work better and more easily for our needs.

Today we use a 12v power supply combined with a din mount triple SPDT relay board. Unlike the SSRs, the SPDT relays do not leak current. While not significant in the capacity of their use, the reliability of the relays has proven to be much better especially when put in use with solenoid valves, such as in the case of gas systems. As a result of the new relay boards, we have to power the coils, in this case they're 12 volts, therefore make the power supply necessary. For some added benefit we wire the 12v power supply inline so that when the e-stop is hit, the power supply shuts off, as does the 110v feeding the pumps, doubling the impact in other words.



In addition to the new relays, we have also upgraded the contactors, providing greater duty life and capacity. With the new 63 amp contactors, there is ample capacity for the systems and up to 6000 watt elements. While the panel internally may have 6000 watt capacity though, it is highly recommend for most applications that you stick with 4500 watt or 5500 watt elements. For 50 amps setups, it is possible to run two 5500 watt elements at the same time, but while one can, it is recommended that you leave some head room between actual use and limits. Meaning, if you have 50 amps, each 5500 watt element will draw approximately 23 amps, for a total of 46 amps attributed to the elements with 2 amps for each pump. For optimal stability it is recommended that at least your boil element be a 4500 watt element, giving some room. If you desire to run 6000 watt, the 30 amp panels are clearly capable, but it is not recommended on the 50 amp design.

Wiring kit breakdown and explanation

BCS Wiring

Yellow - HLT Elements
-- 18ga - 3 cuts, 8 ft for element LED output, remainder to run from BCS to switch and then to SSRs in 50a variations or from BCS to SSRs on heat sink in 30a variations.
-- 14ga - 2 cuts, 1x approx. 6ft from A1 of first contactor to switch, in 4 element panels add a small jumper between A1 of first contactor, and A1 of third contactor
Orange - Boil Elements
-- 18ga - 4 cuts, 2x 10 ft for element LEDs, remainder to run from BCS to switch and then to SSRs
-- 14ga - 2 cuts, 1x ~6ft from A1 of first contactor to switch, small jumper between A1 of second contactor, and A1 of fourth contactor
Blue - Water Pump
-- 18ga - Loop from BCS to switch to relay
-- 14ga - Short run from relay to outlet
Purple - Wort Pump
-- 18ga - Loop from BCS to switch to relay
-- 14ga - Short run from relay to outlet
Gray - Alarm output
-- 18ga - Short run to Relay
-- 14ga - 4 ft run from relay to toggle switch on door
Tan - Input Button
-- 18ga - From BCS to push button
Red - 5v+ & 120v Hot
-- 18ga - 5v constant daisy chains from 5v+ on BCS to NO block on each of the 4 switches for element and pumps and ends at input button, I'll often use for the main power led as well
-- 14ga - runs from terminal blocks off of Breaker and runs to the e-stop
Black
-- 18ga - Usually use for temp probes
-- 14ga - Daisy chain 110v power on switches, from terminal block to the din outlet, key switch loop
White
-- 110v Common and 5v+ BCS Ground
Green
-- Grounding on pumps and enclosure.

PID Wiring

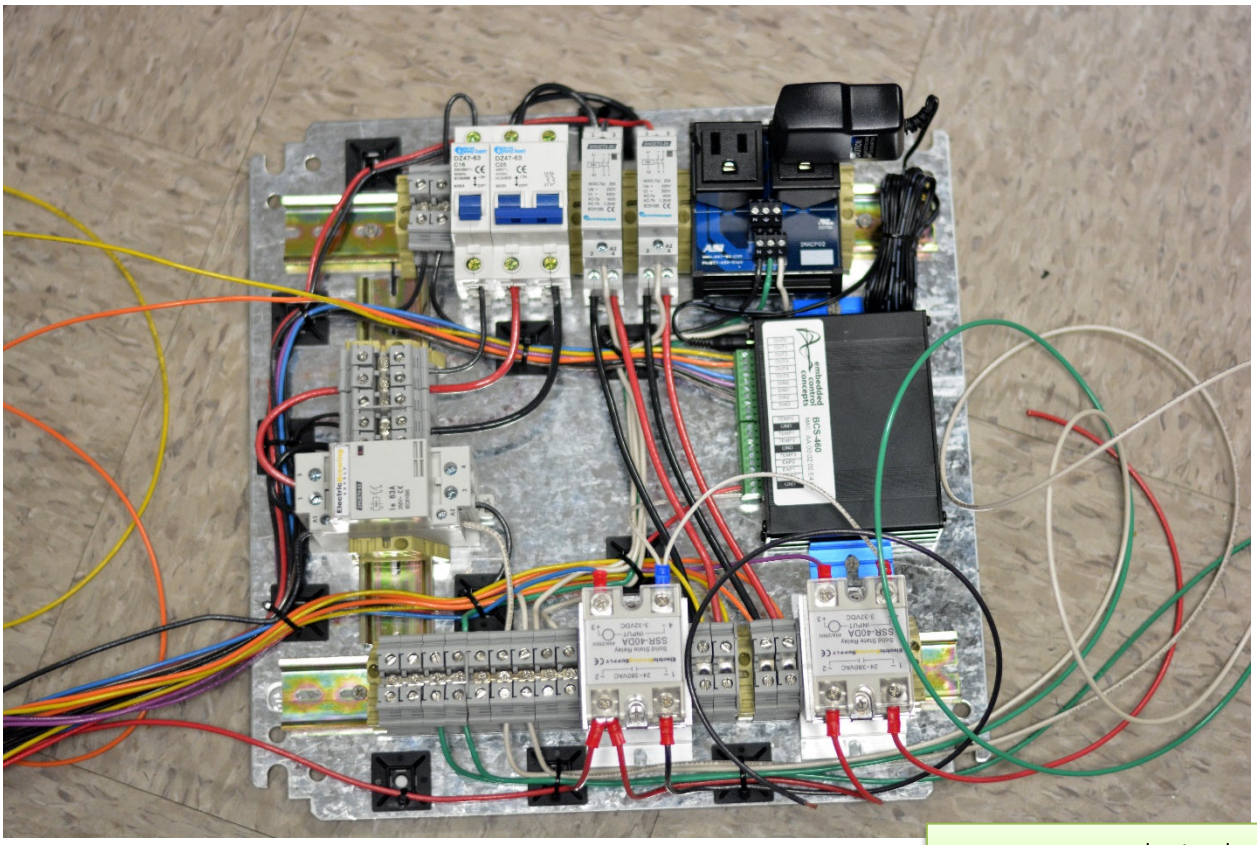
Yellow - HLT Elements
-- 18ga - 2 cuts, 8 ft for element LED output, remainder to run from PID to SSR on heat sink
-- 14ga - 1 cut, 1x approx. 4ft from A1 of first contactor to switch. In 4 element designs, 6 ft cut with a small jumper between A1 of first contactor, and A1 of third contactor
Orange - Boil Elements
-- 18ga - 4 cuts, 2x 10 ft for element LEDs, remainder to run from BCS to switch and then to SSRs
-- 14ga - 1 cut, 1x approx. 4ft from A1 of first contactor to switch. In 4 element designs, 6 ft cut with a small jumper between A1 of first contactor, and A1 of third contactor
Blue - Water Pump
-- 14ga – Run from pump outlet to switch on door
Purple - Wort Pump
-- 14ga – Run from pump outlet to switch on door
Gray - Alarm output
-- 14ga – Daisy chain from alarm outputs to 2-way switch before buzzer
Tan - Start Button
-- 18ga – loop to alarm through push button and back to alarm
Red – temp probes & 120v Hot
-- 18ga – use for main power LED
-- 14ga - runs from Breaker and runs to the e-stop
Black - 110v connections
-- 14ga - Daisy chain 110v power on switches and PIDs, key switch loop
White
-- 110v Common
Green
-- Grounding on pumps and enclosure.

6ga and 10ga Wiring

6ga Black to be used in 50a panels, connects from the inlet in to the main contactor, as well as common cluster. From the main contactor to the terminal blocks used to distribute the power to the breakers.

10ga Black and Red are used from the distribution terminals to the breakers, from the breakers to the SSR and contactor, then to the outlet.

10ga Green is used to ground each element outlet and from the inlet to the inside cluster.

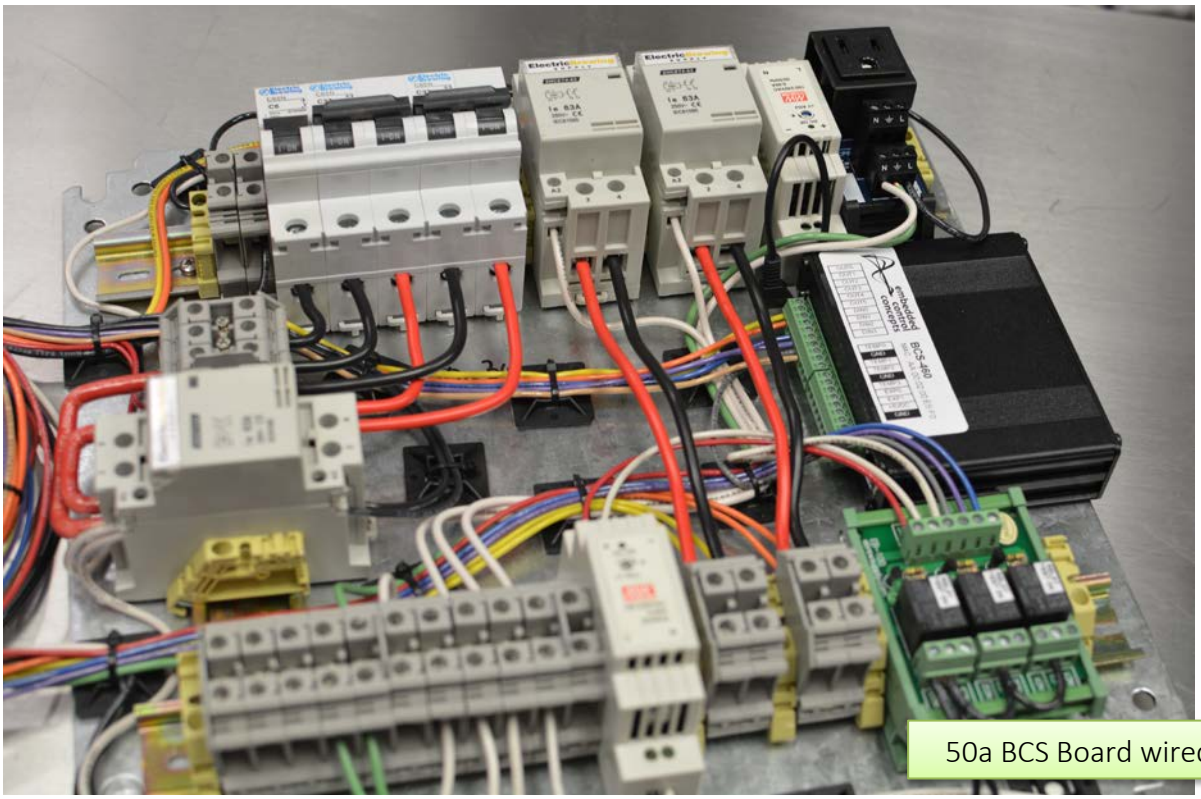


30a BCS Board wired

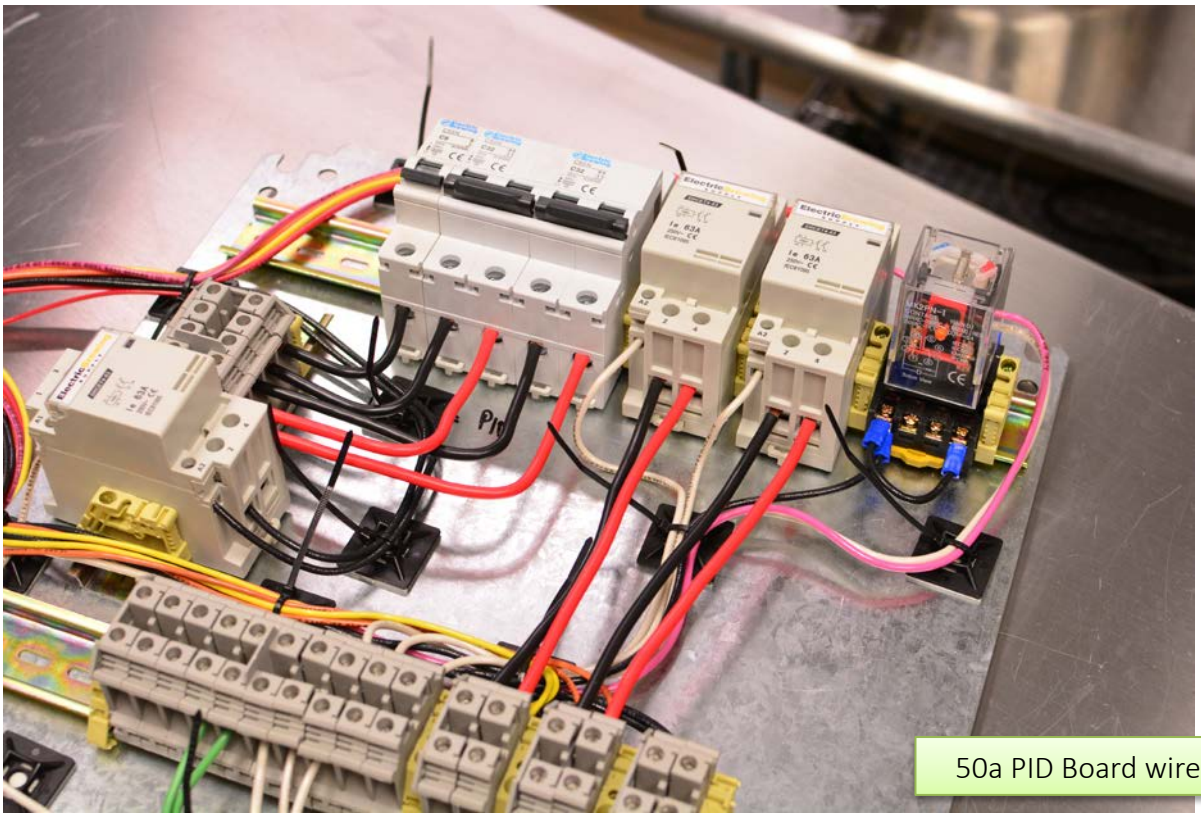
In order to speed up the wiring, colors are used for quick identification, in this case yellow 18ga will be HLT, orange will be Boil, while blue will be water pump, and purple the wort pump. It is also important to note that the colors are used on the BCS signal lines primarily here. From the BCS the wire is run to the door. For the 50a design it is important to note that each colored wire is run to the door. In the 30a design, because you are selecting which element to use only, the orange and yellow, from the BCS will go directly to the relays on the heat sink instead of to the door.

The 14 ga 110v wire is either black or red in the picture. With the 110v line, there are basically 3 paths from the door to the enclosure that must be identified from the 5 that come from above board: 1) The main power to the door from the breaker line. 2) the loop back for the main power switch that runs from one leg of the contactor to the door and back to the contactor coil – this can be cut as one long loop back. 3 and 4) The power from the switch(es) on the door for to the contactors for the elements. 5) The power from the e-stop to the first pump relay, which is then daisy chained to the second.

Since the picture is of a 30a board, the orange and yellow wire from the BCS is set aside already to be connected to the relays on the heat sink.



50a BCS Board wired



50a PID Board wired

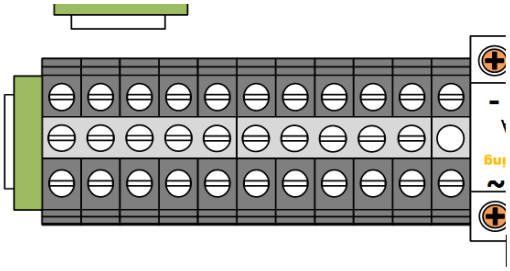
** Bottom right 2 terminal blocks are for the 2 pump wires to the door. From these two blocks we'll connect to the outlets.

Wiring Diagram tips

While reading the included diagrams below as well as wiring schematics, there are a few notes to remember. The schematics are a working diagram the wiring, but diagrams that follow are showing you in practice how best to wire your setup. The lines best mimic the paths for your wiring. Is this the only choice, certainly not, but these layouts have performed well.

DIN Terminal layout tips

When looking at the layout drawings, you will find that the terminal blocks are in clusters. While it was hard to show clearly, there is in fact a line between groupings in the middle screw sections. This is where you would then place a spacer. An open hole in the center indicates no terminal bridge:



For the groupings, you will also note that they aren't groupings of 10 but in this case 5, and in other spots 2, 3, and 2. For these, the terminal bridges are easily snipped down to size with your wire cutters as pictured below. It is also important to cover any exposed metal of terminal blocks with the larger flat end covers, this protects the circuit from shorting and any other less desired issues.

Wiring Layout Diagrams

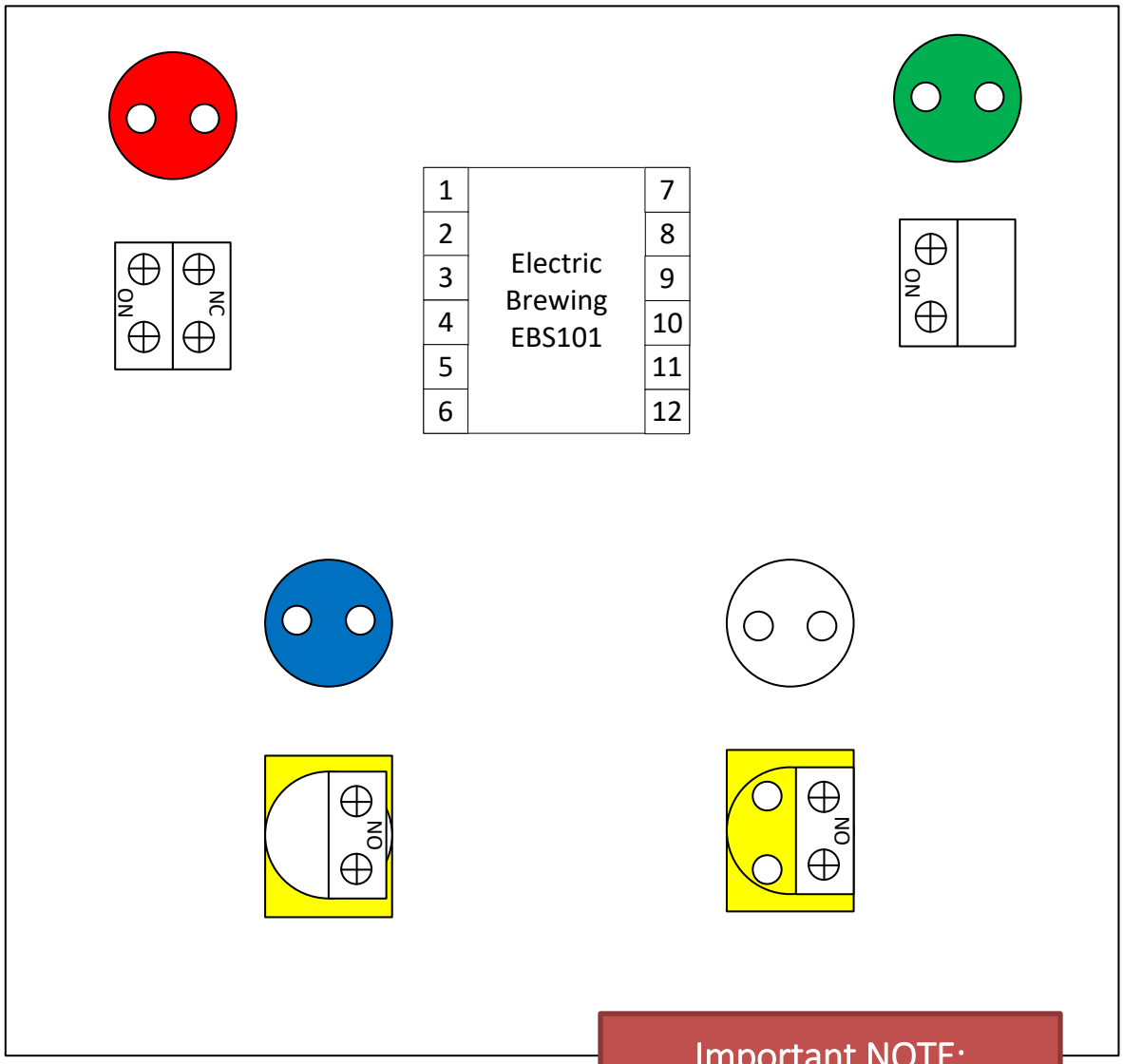
There have been a number of revisions over the past few years to the layouts used in building our PID, BCS, and the newest BIAB designs. The following sections address each design; BIAB (Brew-In-A-Bag) is our smallest panel and has the simplest design as there is only one size. For BCS and PID layouts there can be some variance between the basic DIY kits and the complete DIY kits. The reason for the variance is a reflection of our in shop goal of standardization to insure faster turnaround and clearer understanding.

The main variance between the basic DIY and the complete DIY is that all complete kits ship with a 50a sub panel hardware package. This means there are 2 breakers; not much else differs. The reason for this is it simplifies the wiring process, and it also adds some build reliability.

What this means as the builder is that when following the recommendations, if you have a 30a kit, you will still follow 30a door wiring steps, but the 50a sub panel layouts. For the BCS there is one difference to note however, the yellow and orange 18 gauge from the BCS will go to the SSRs and not the door.

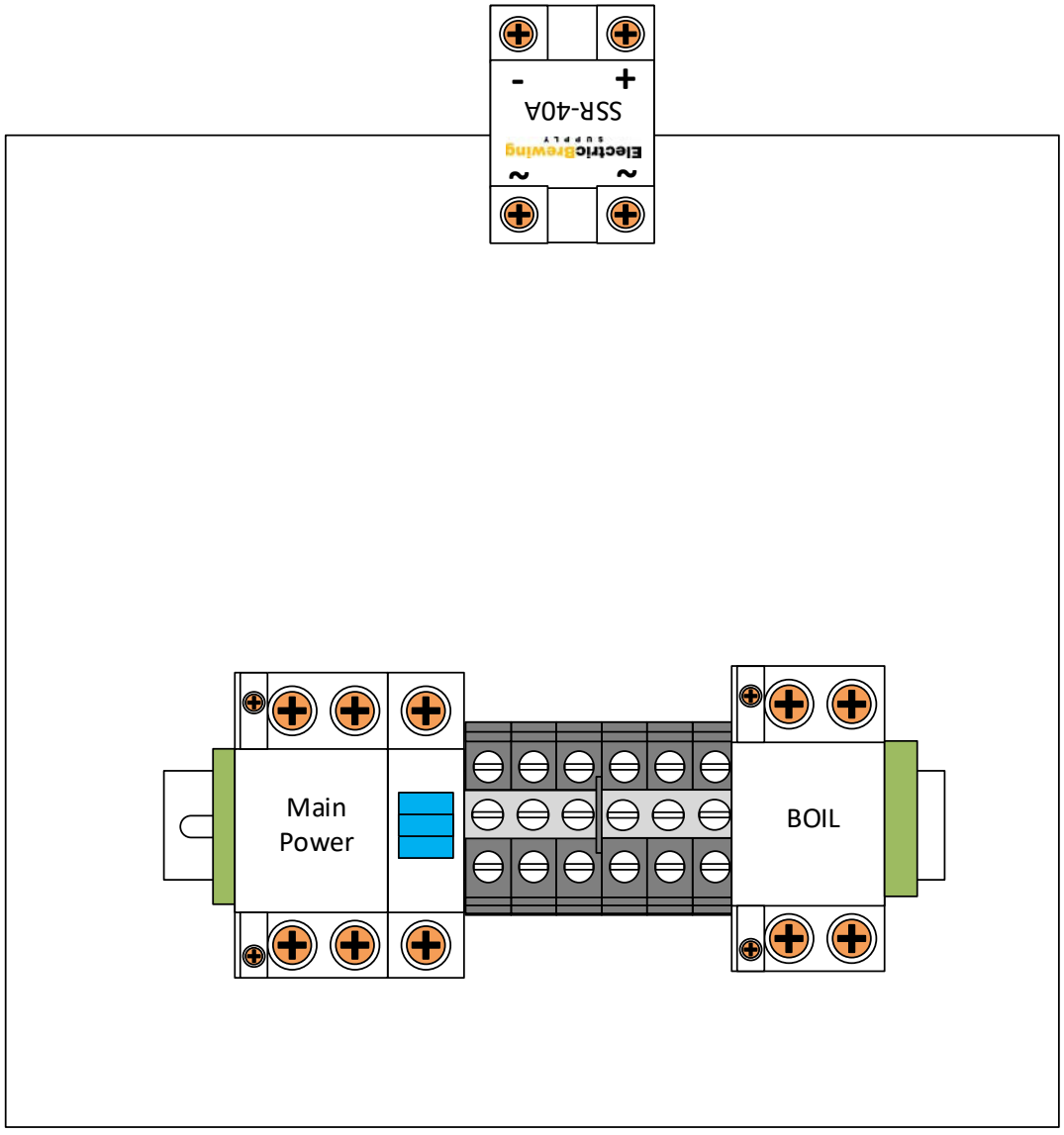
BIAB Build

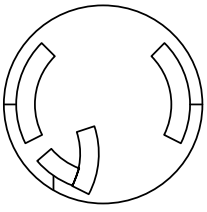
BIAB Door Back Side

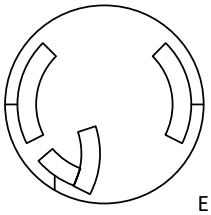


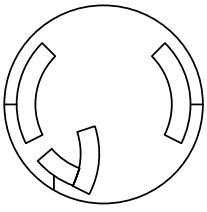
Important NOTE:
Remove the NC Block from the back of your yellow switch after you mount it.

BIAB Sub Panel Layout – w/ SSR

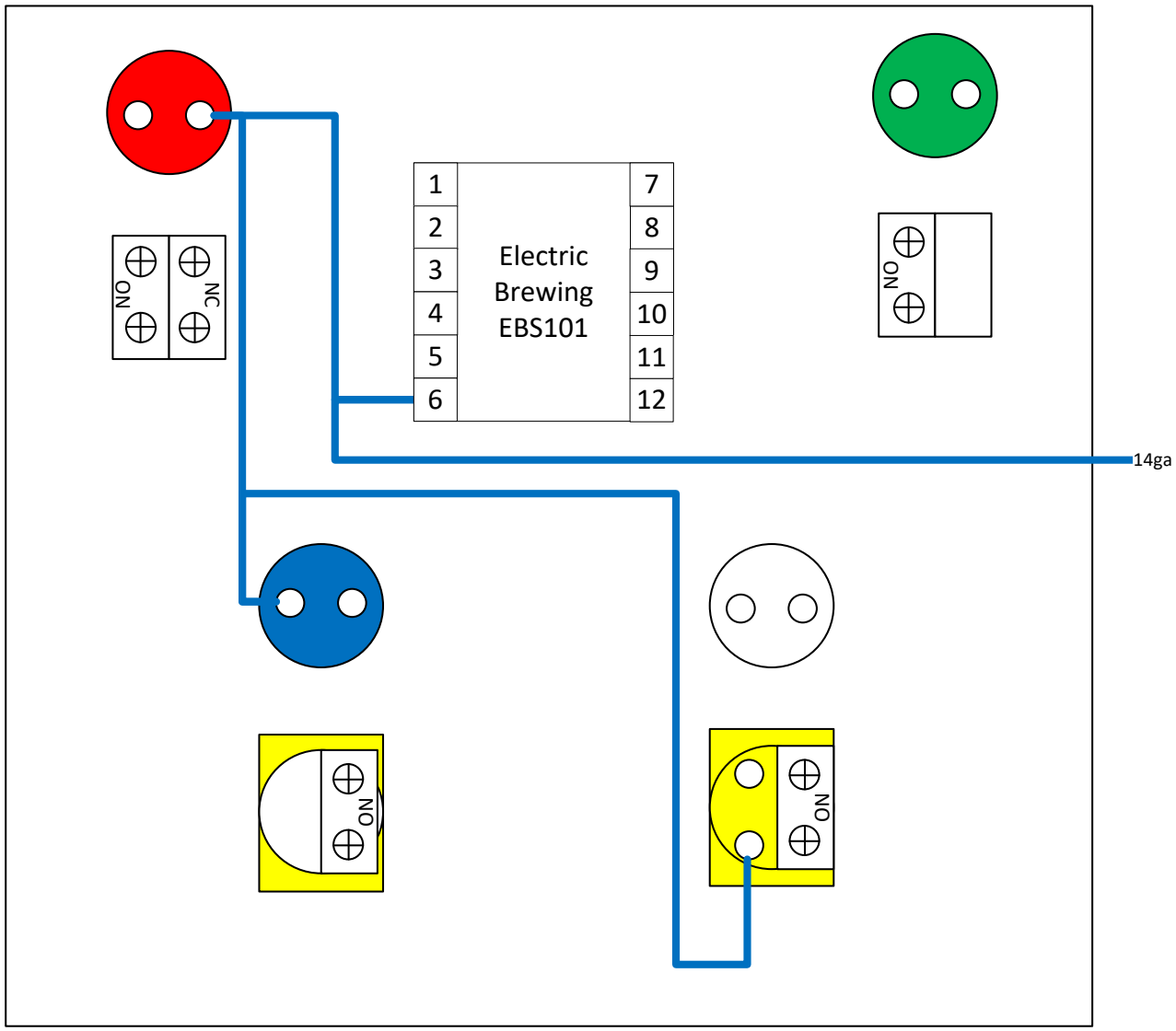



Power

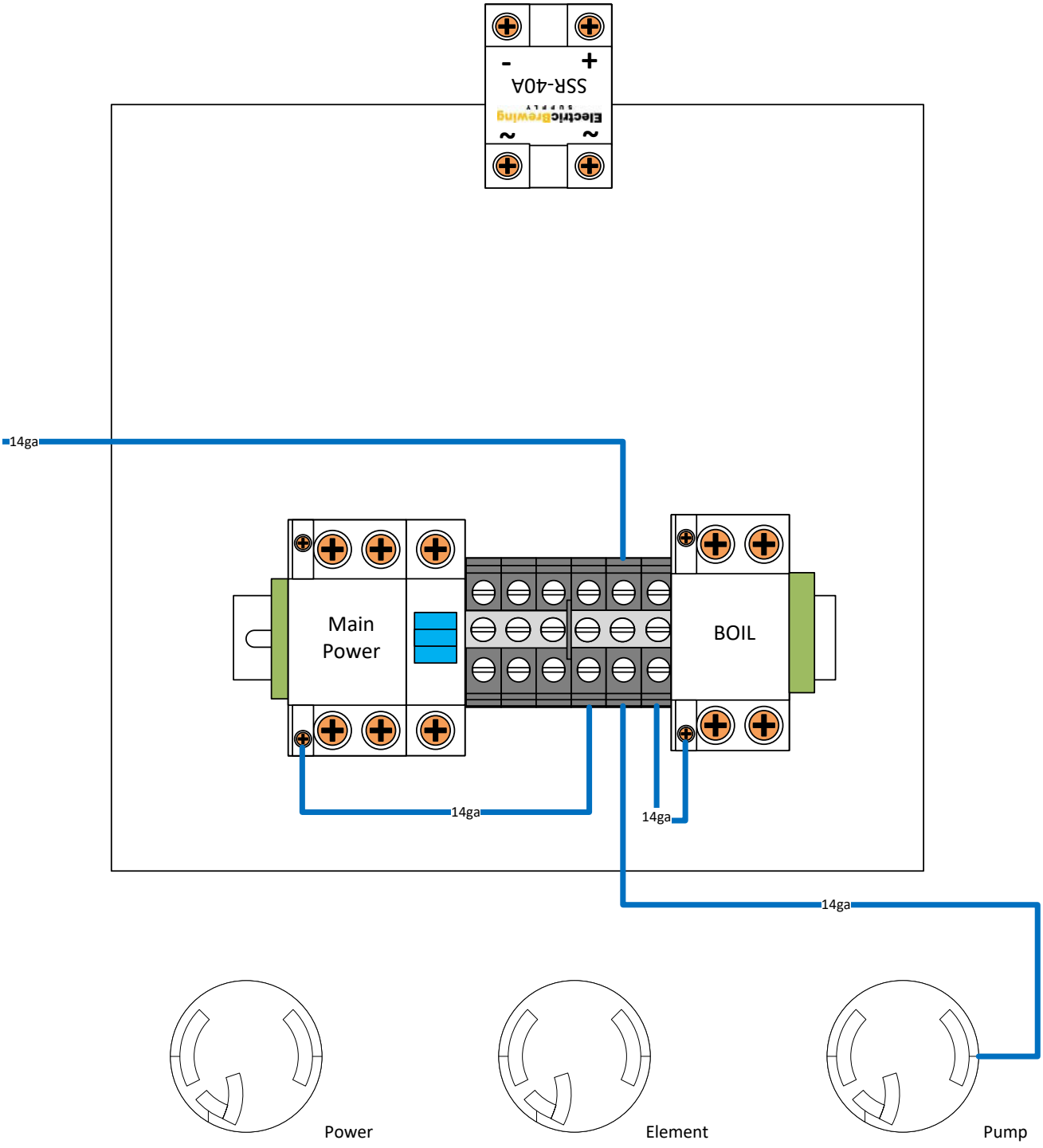

Element


Pump

BIAB Common Door side (white 14ga wire)

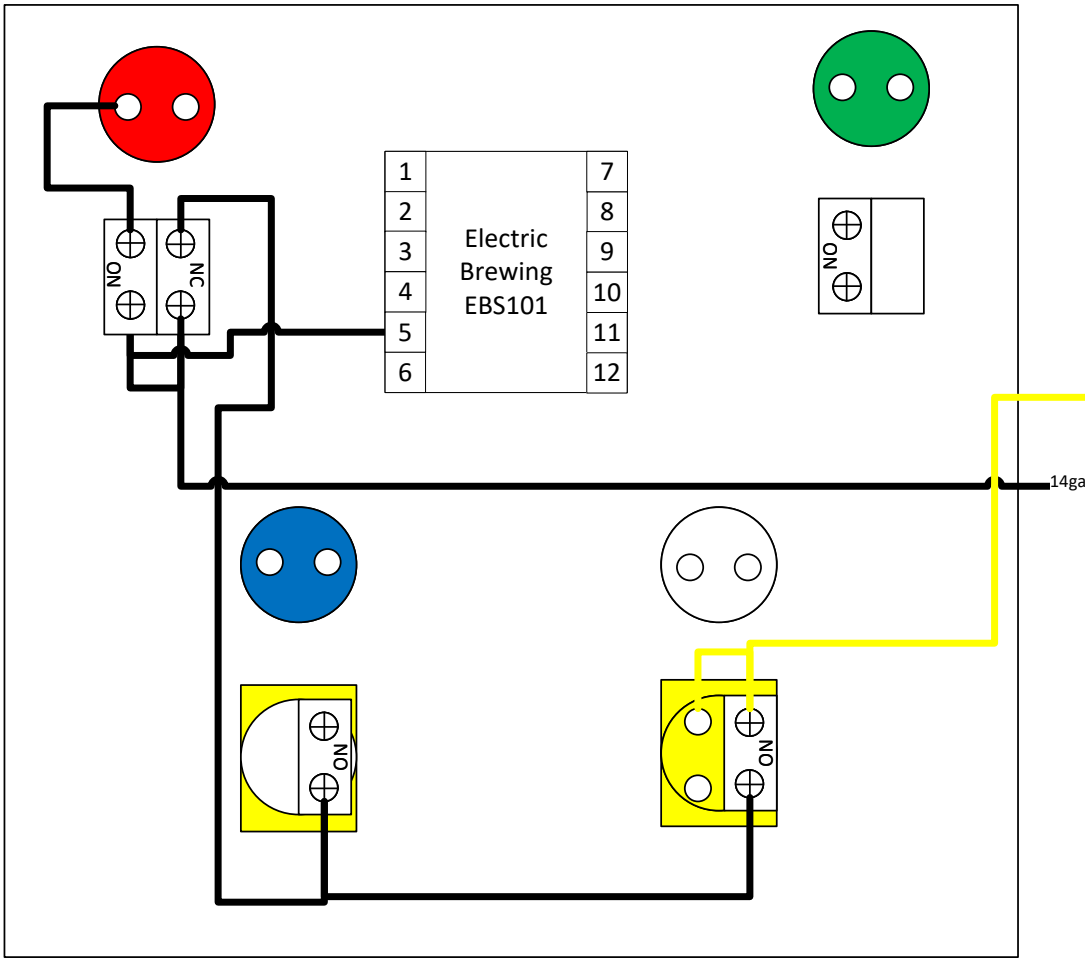


BIAB Common sub panel side (white 14ga wire)

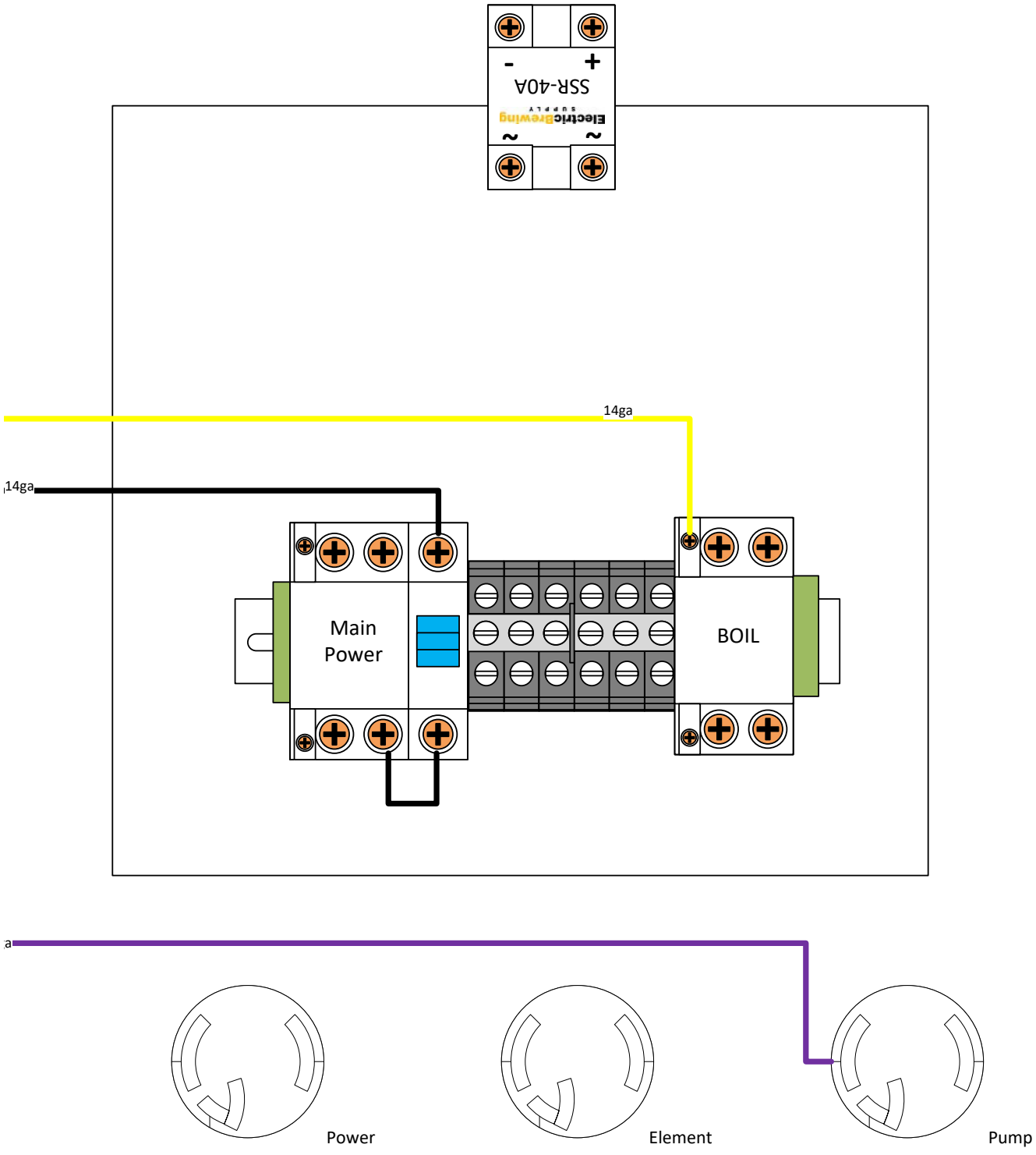


BIAB 110v Hot Door side (14ga wires)

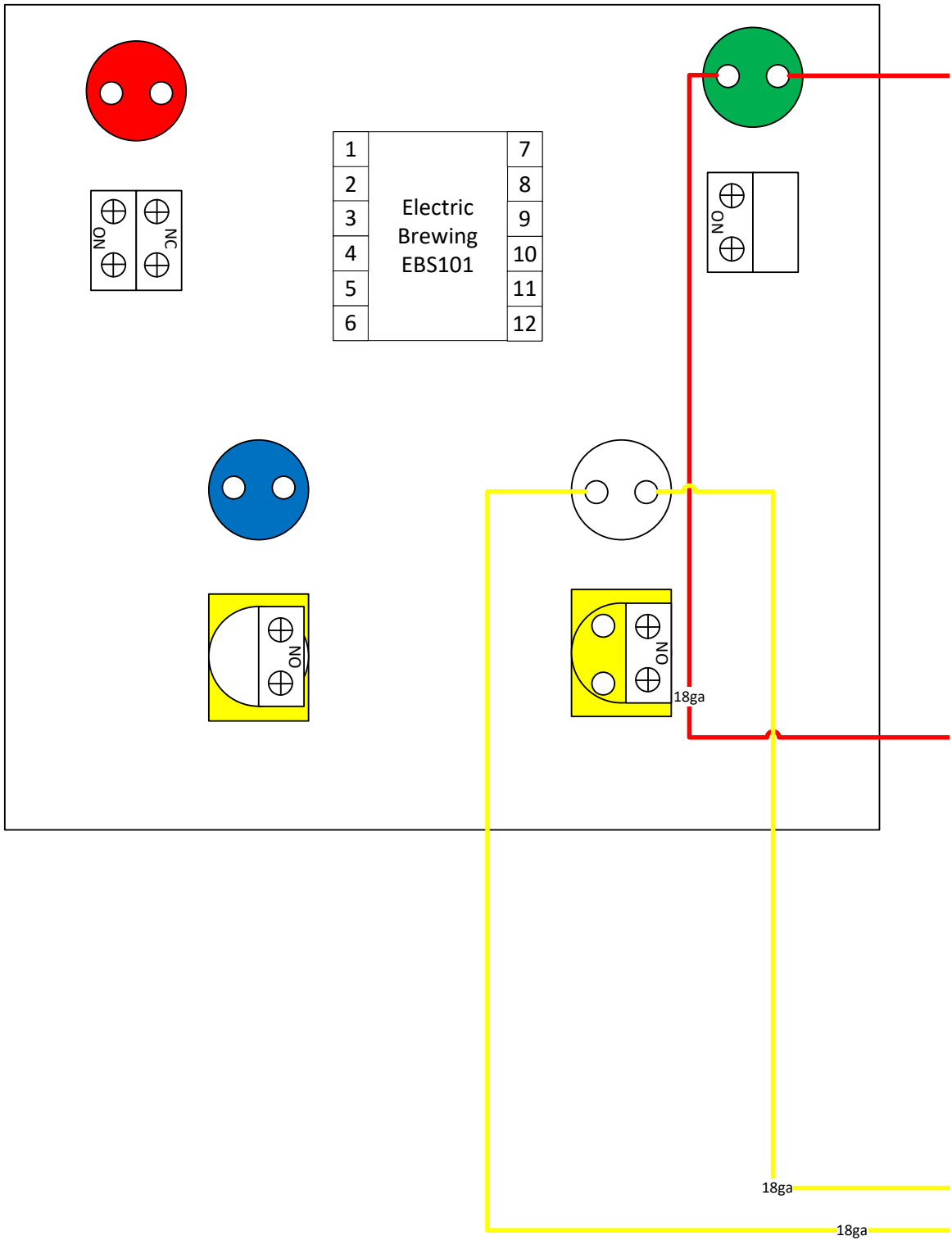
Use blue for the pump side and yellow for the element contactor. Black from the e-stop and red from the breaker.



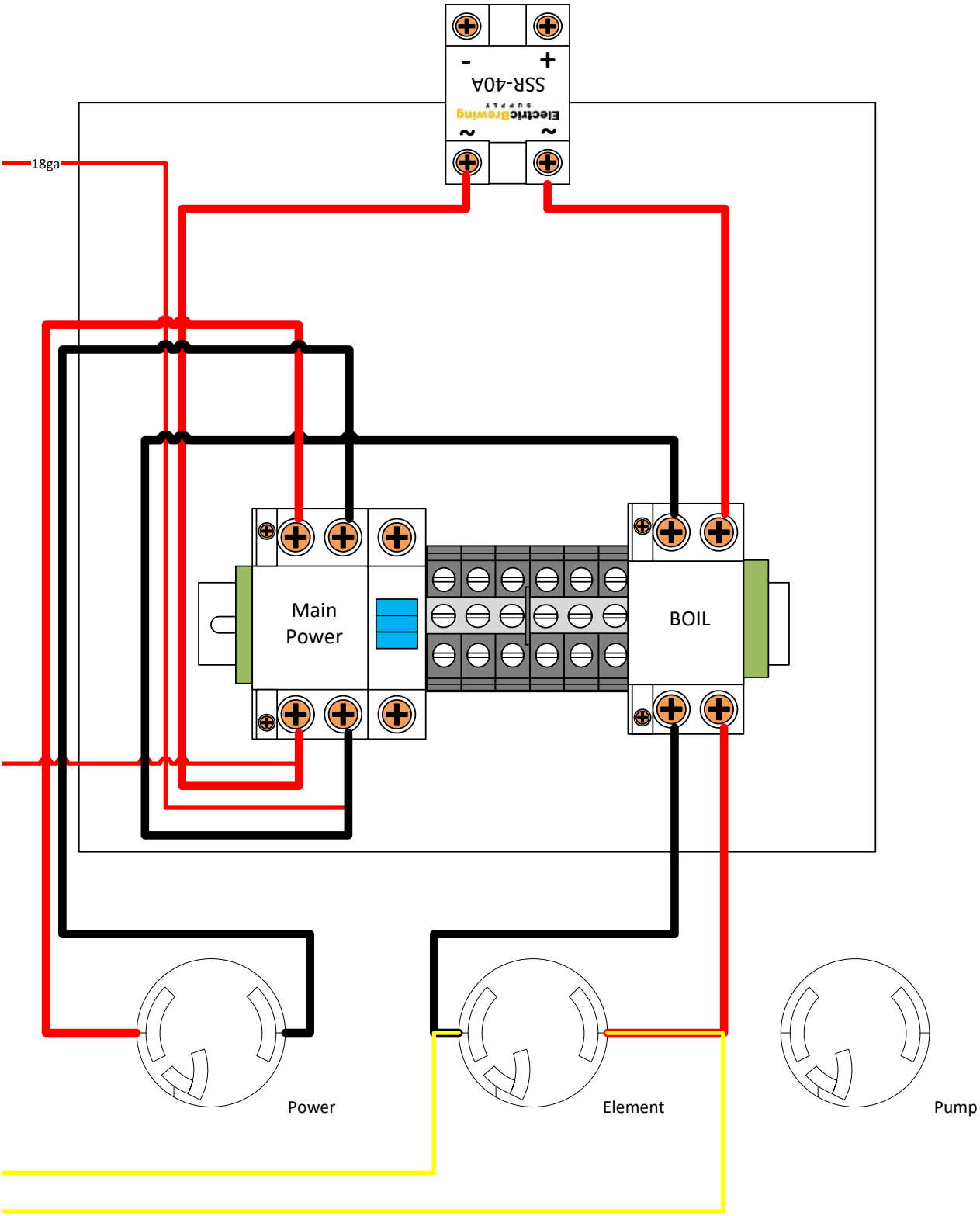
BIAB 110v hot sub panel side (white 14ga wire)



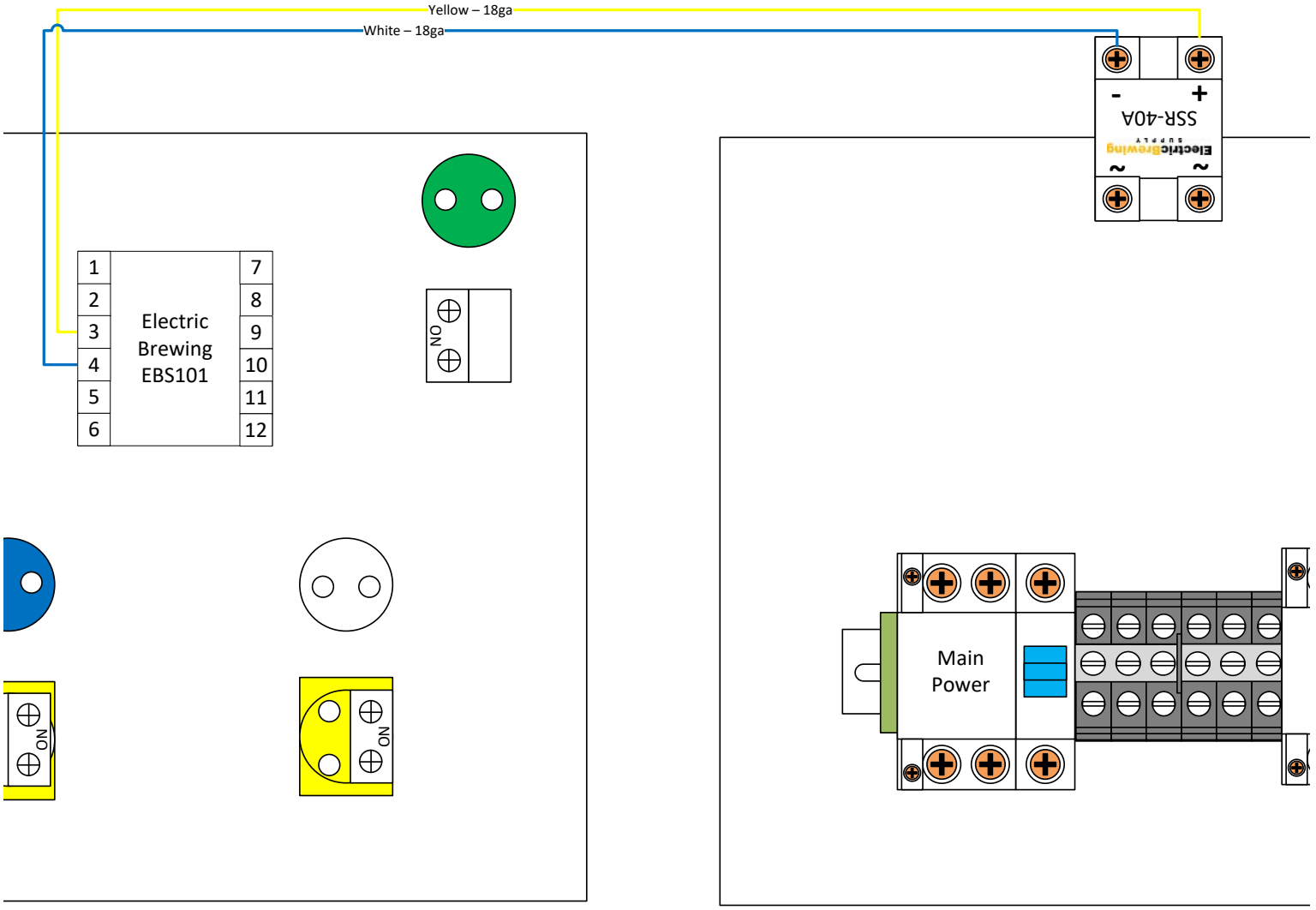
BIAB 220v Door side



BIAB 220v Sub panel side

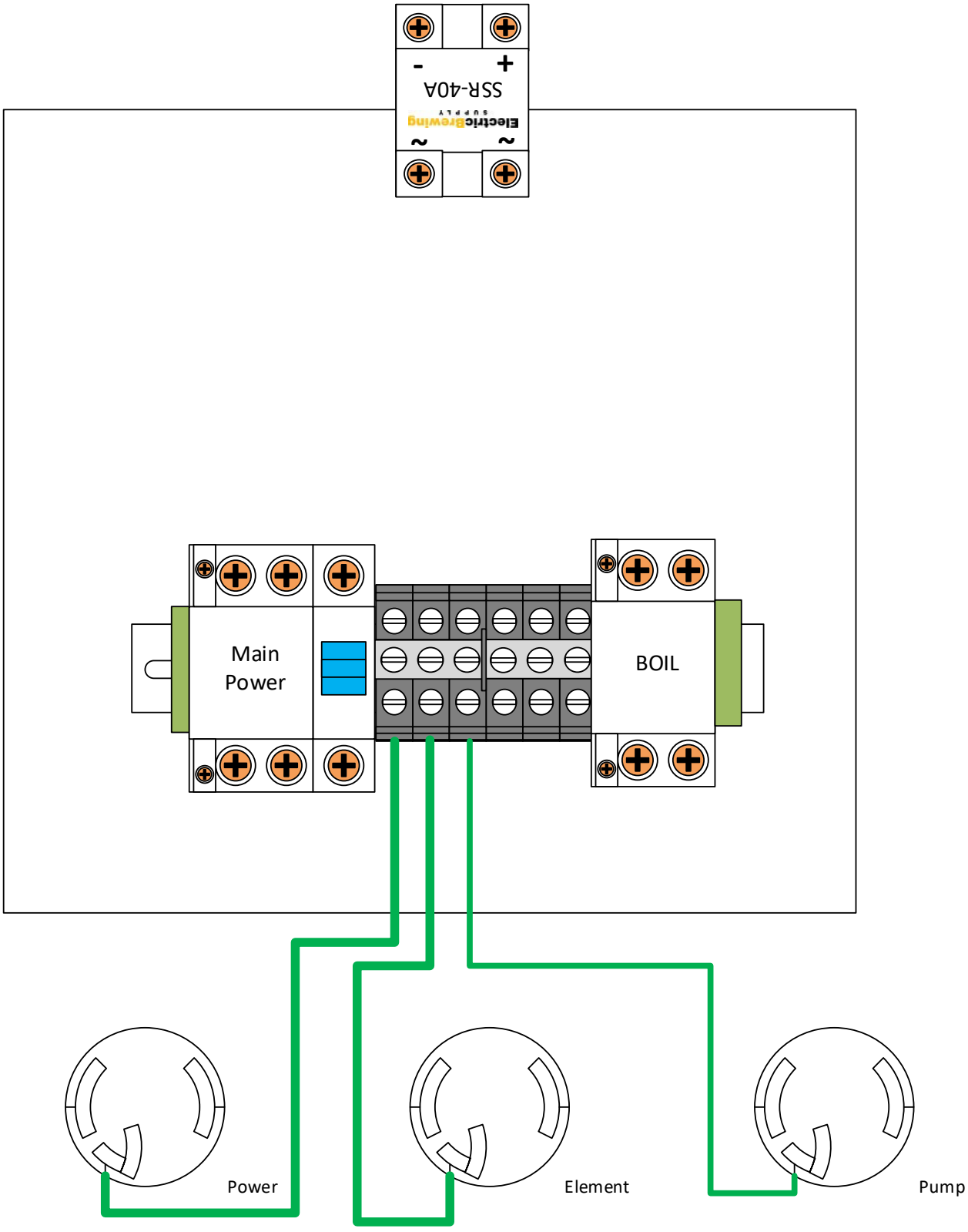


BIAB SSR Control circuit



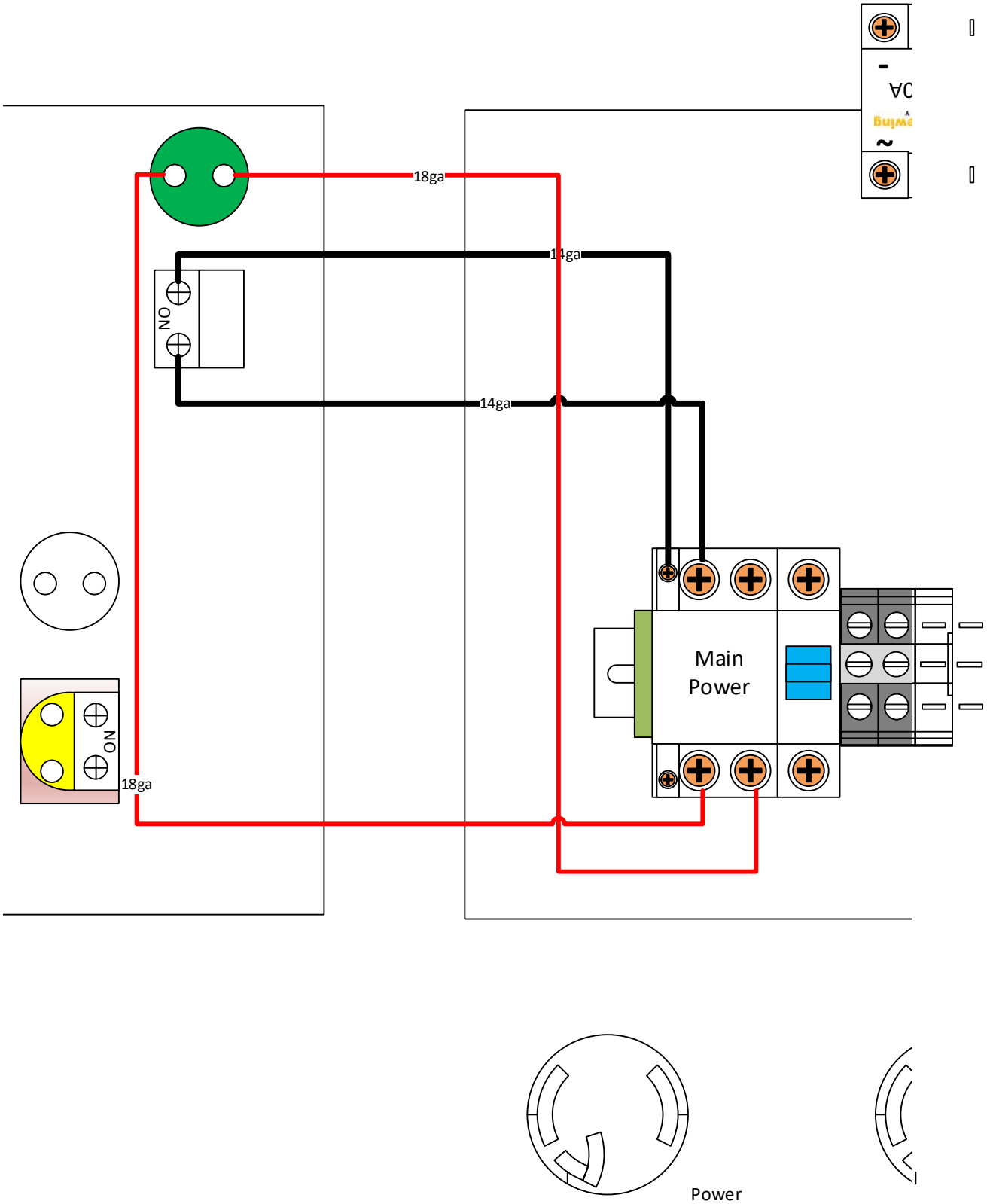
BIAB Ground Wires

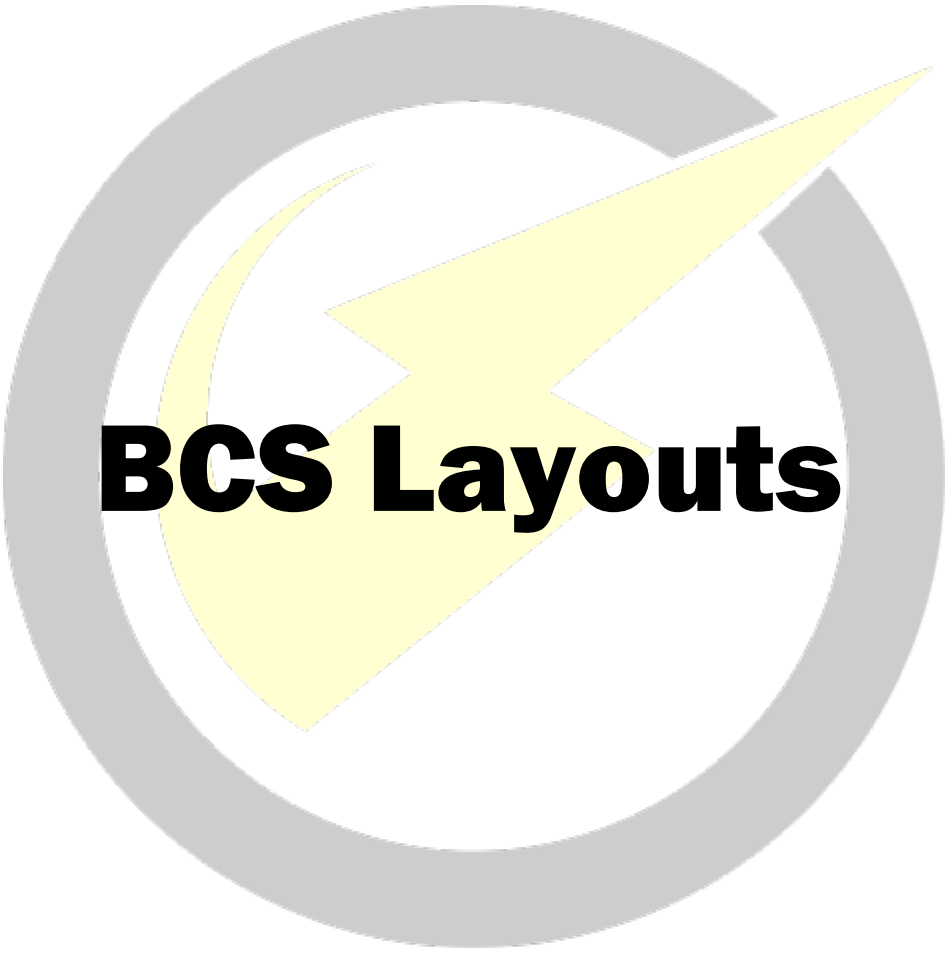
Use 10ga green for inlet and element, 14ga for pump



BIAB Main Power

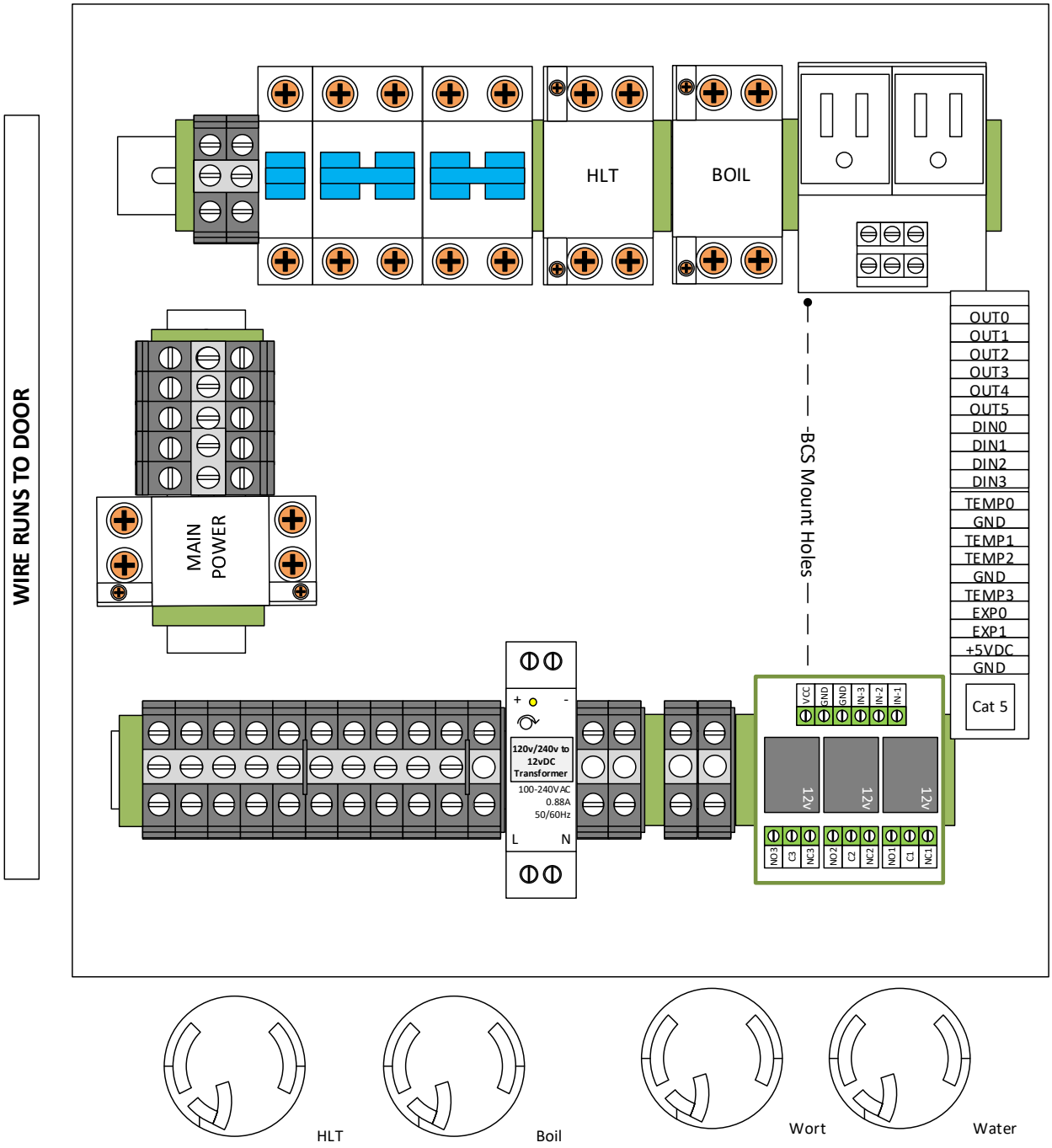
Use approximately 4ft loop from Main contactor pins to the key switch, 18ga red wire is approx. 4 ft looped from the pins.



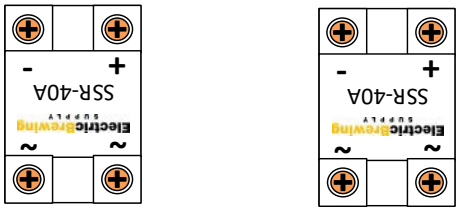


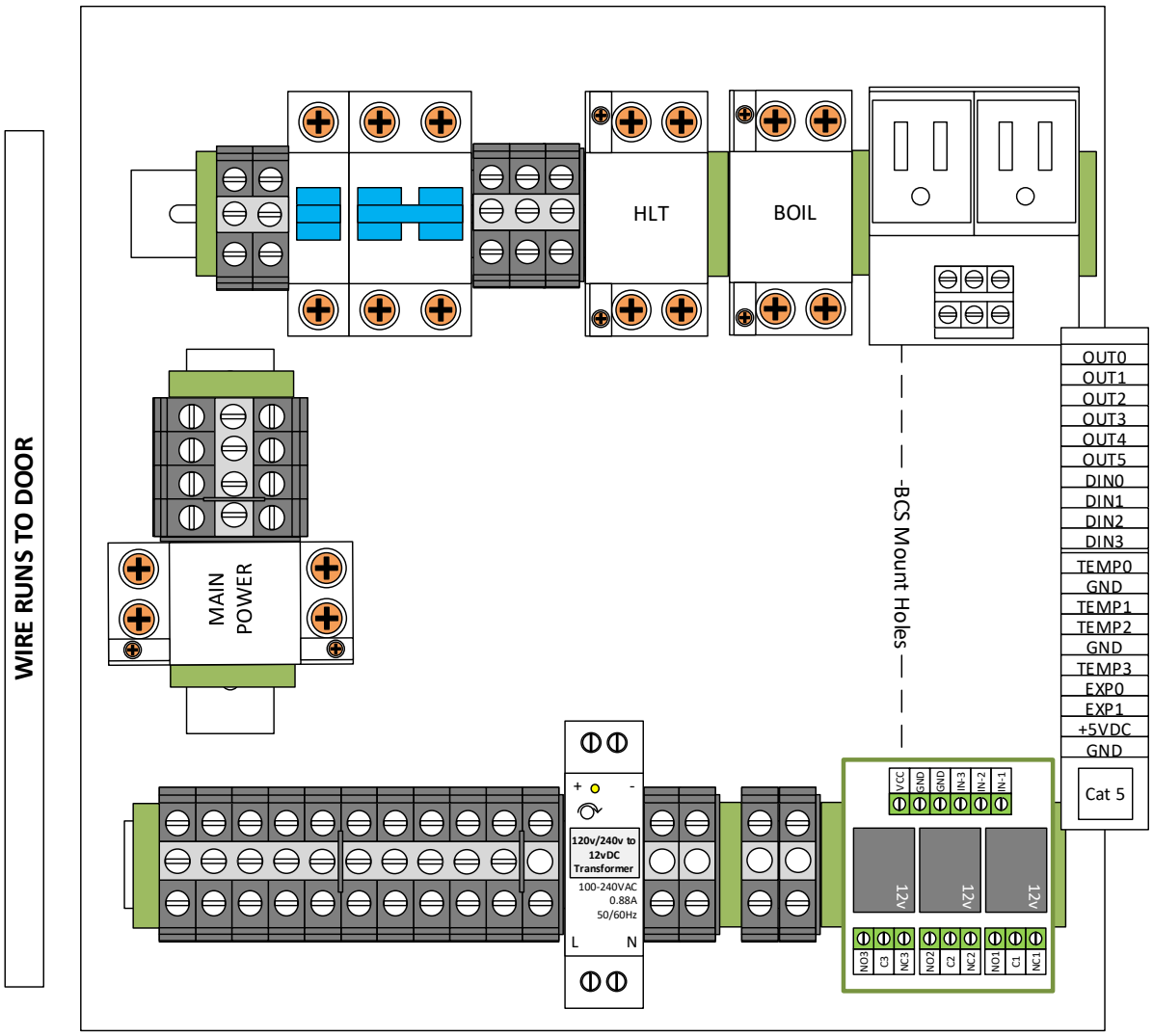
BCS Layouts

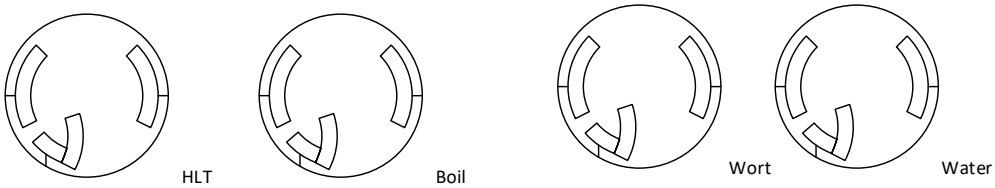
50a BCS Inside Sub Panel Board



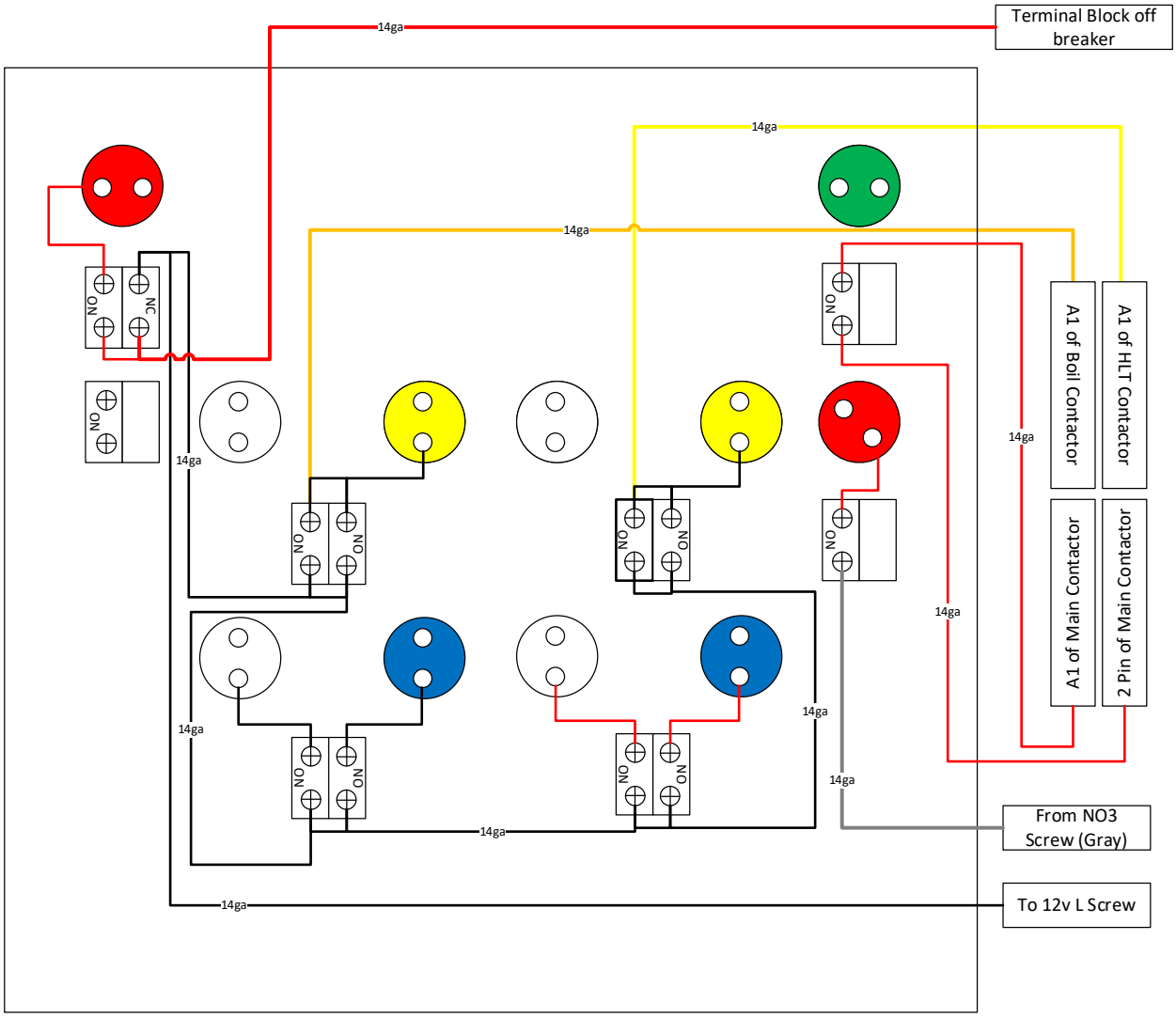
30a BCS Inside Sub Panel Board



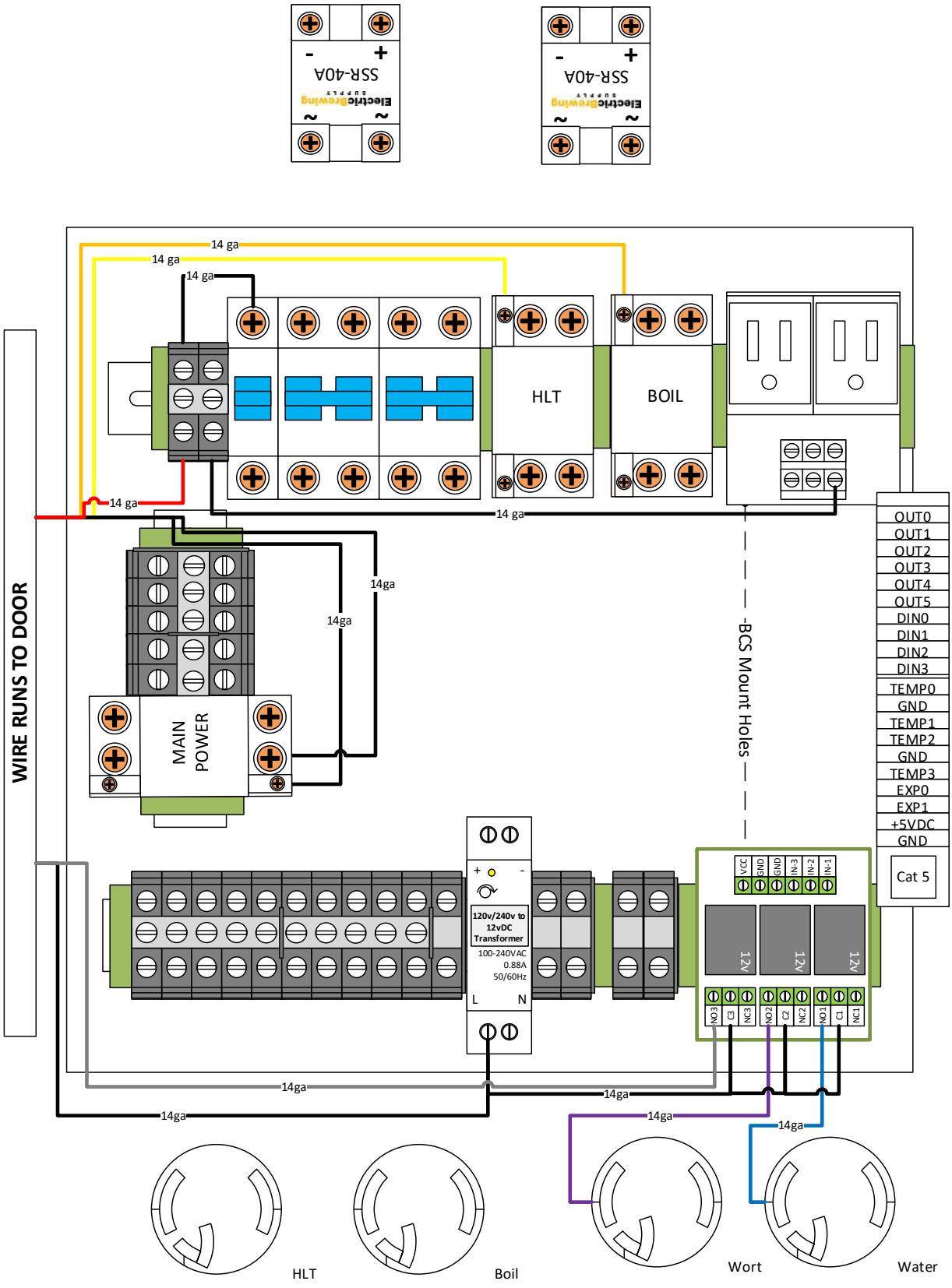




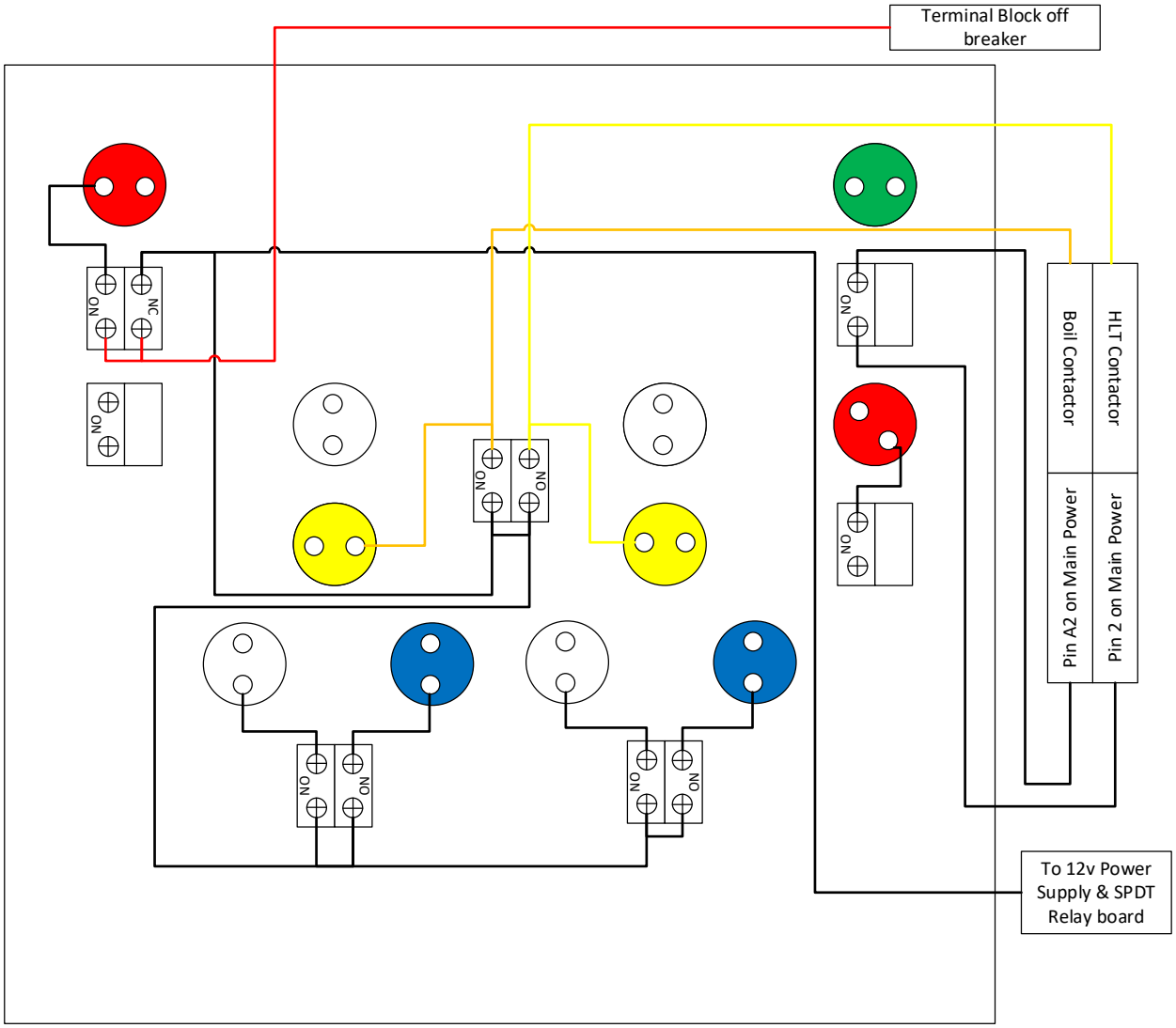
50a BCS 110v Door side wire



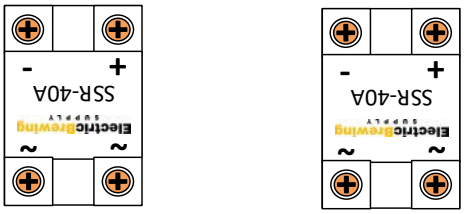
50a BCS 110v enclosure wire up

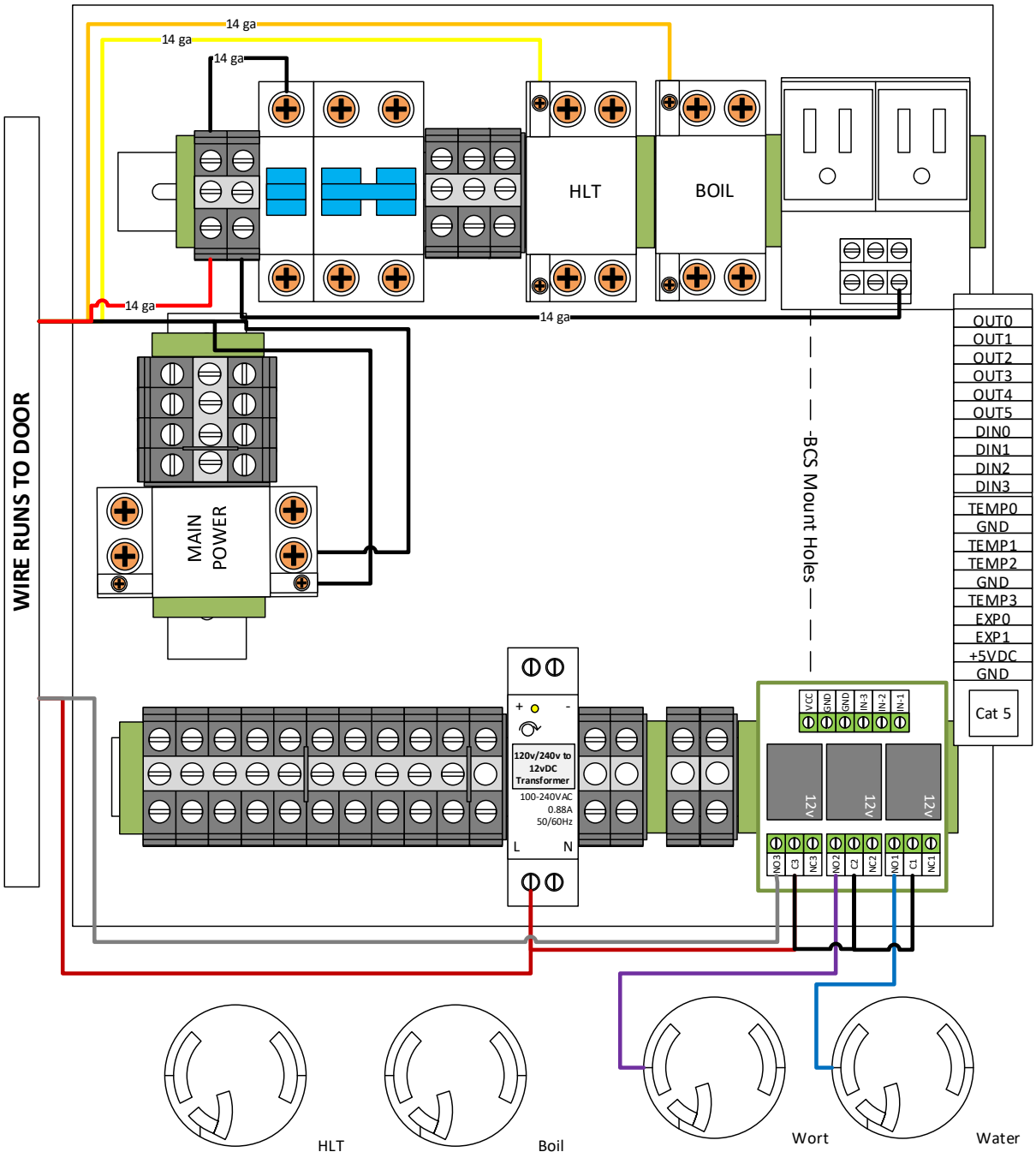


30a BCS 110v door wire up

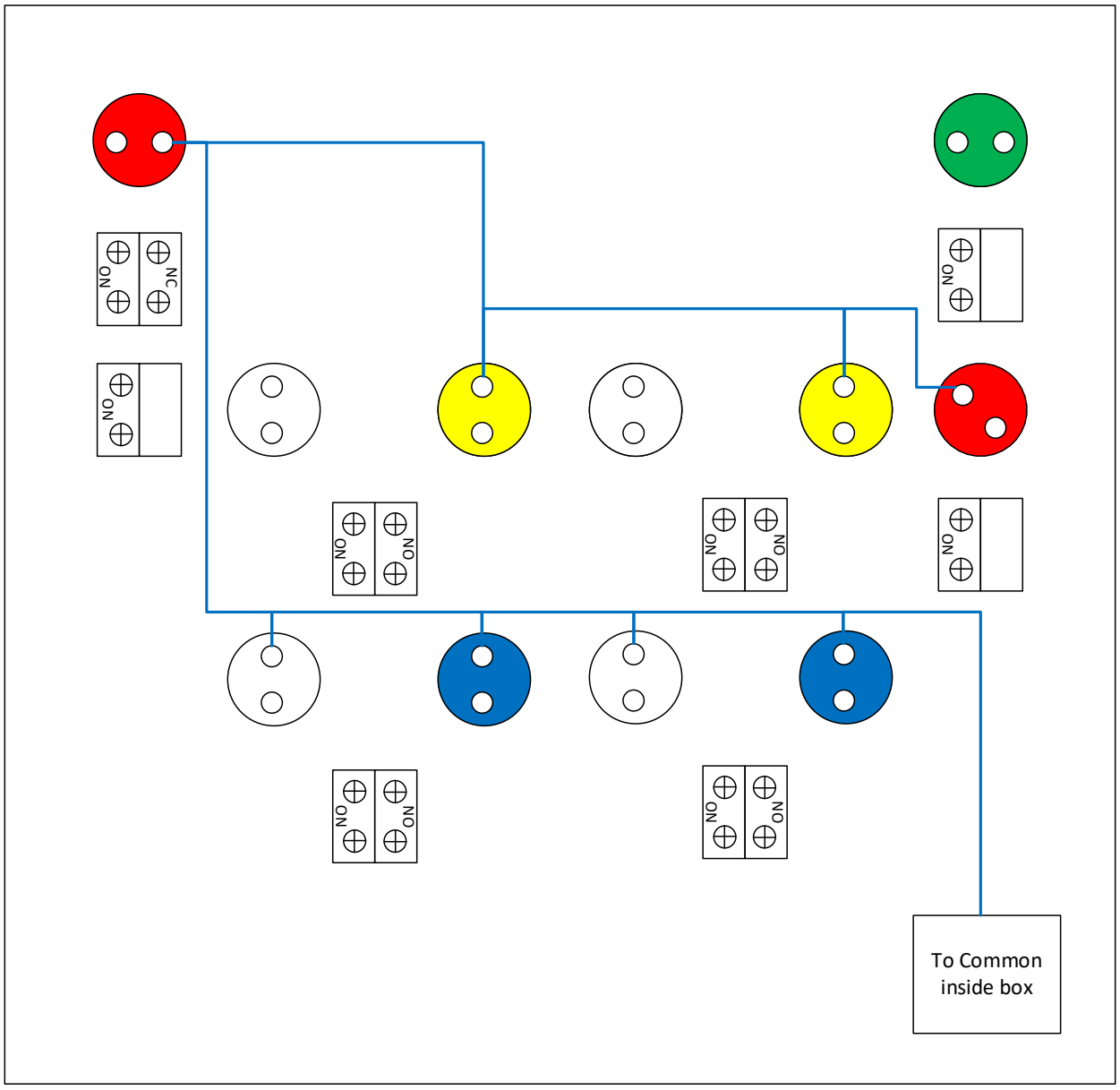


30a BCS 110v Wiring

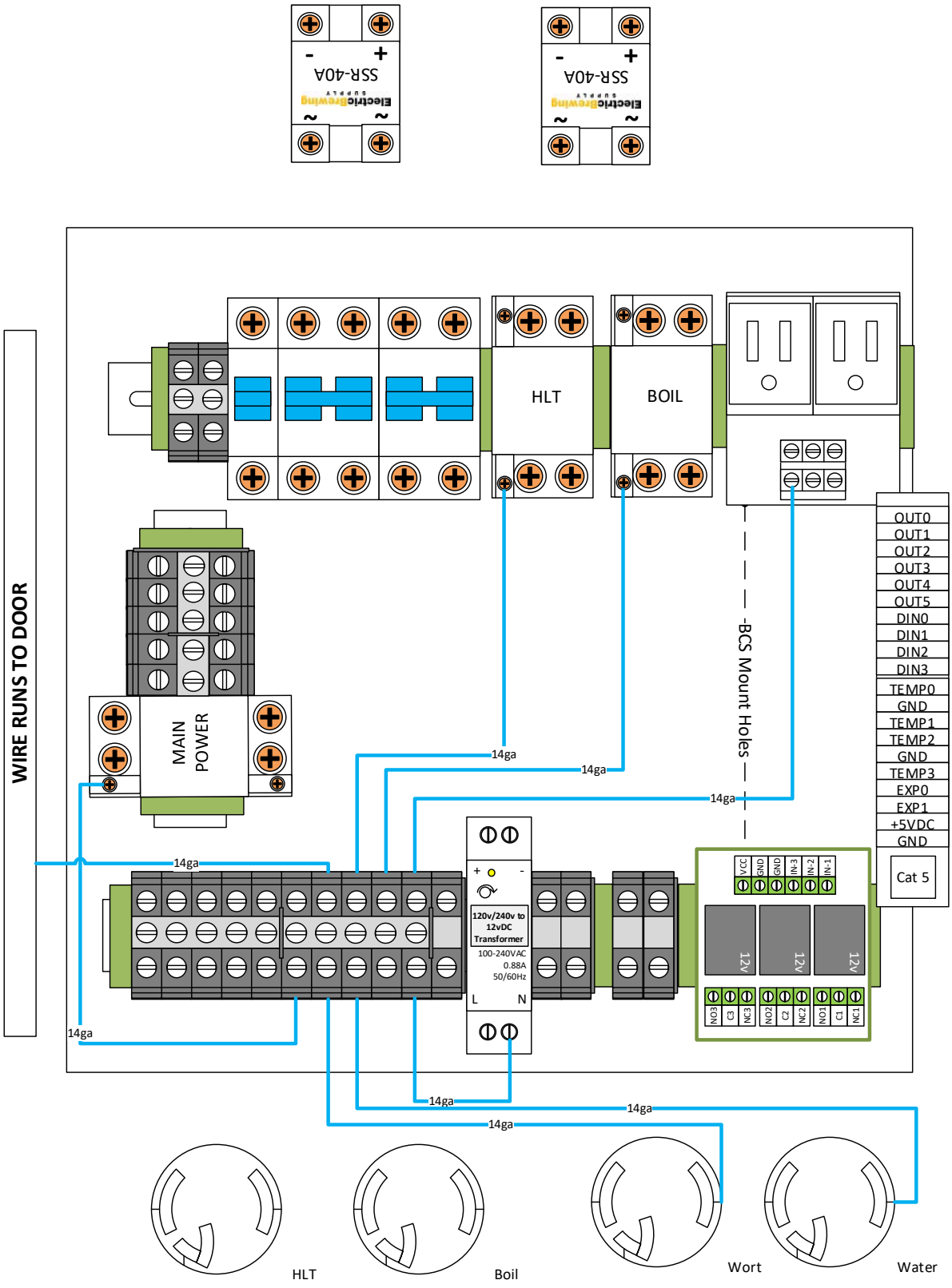




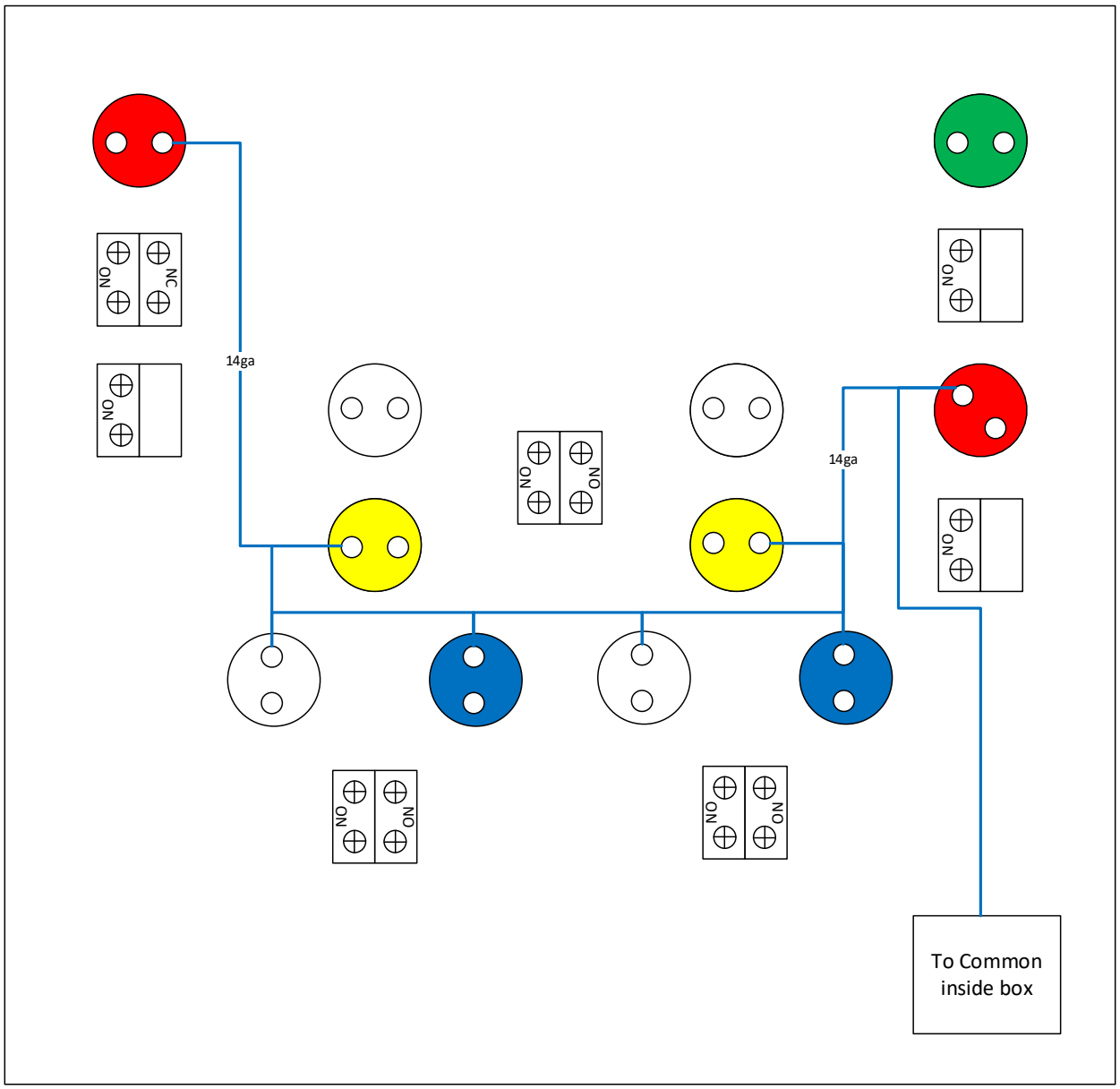
50a BCS 110v Door Common wire



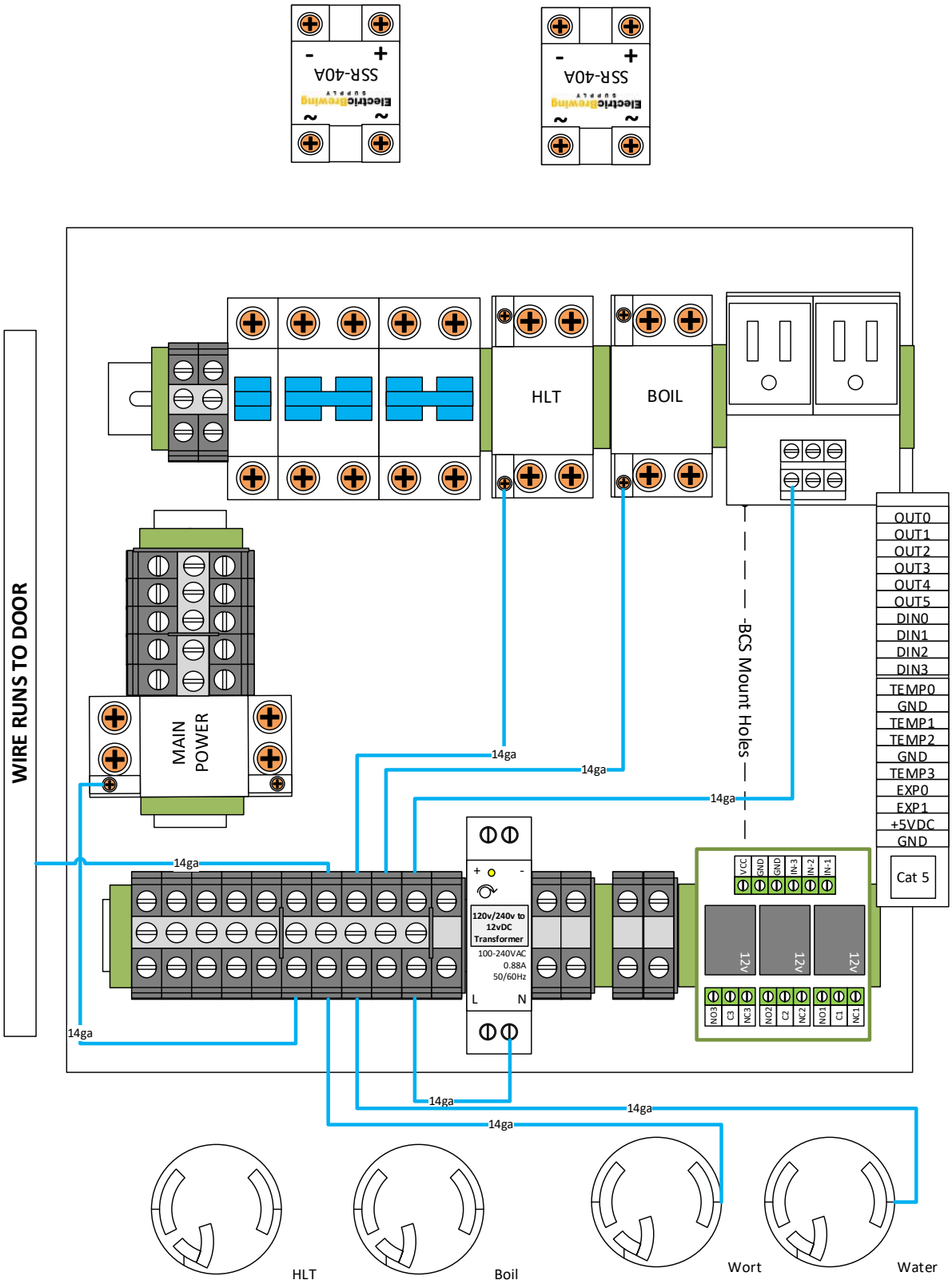
30a BCS 110v Common Wire up



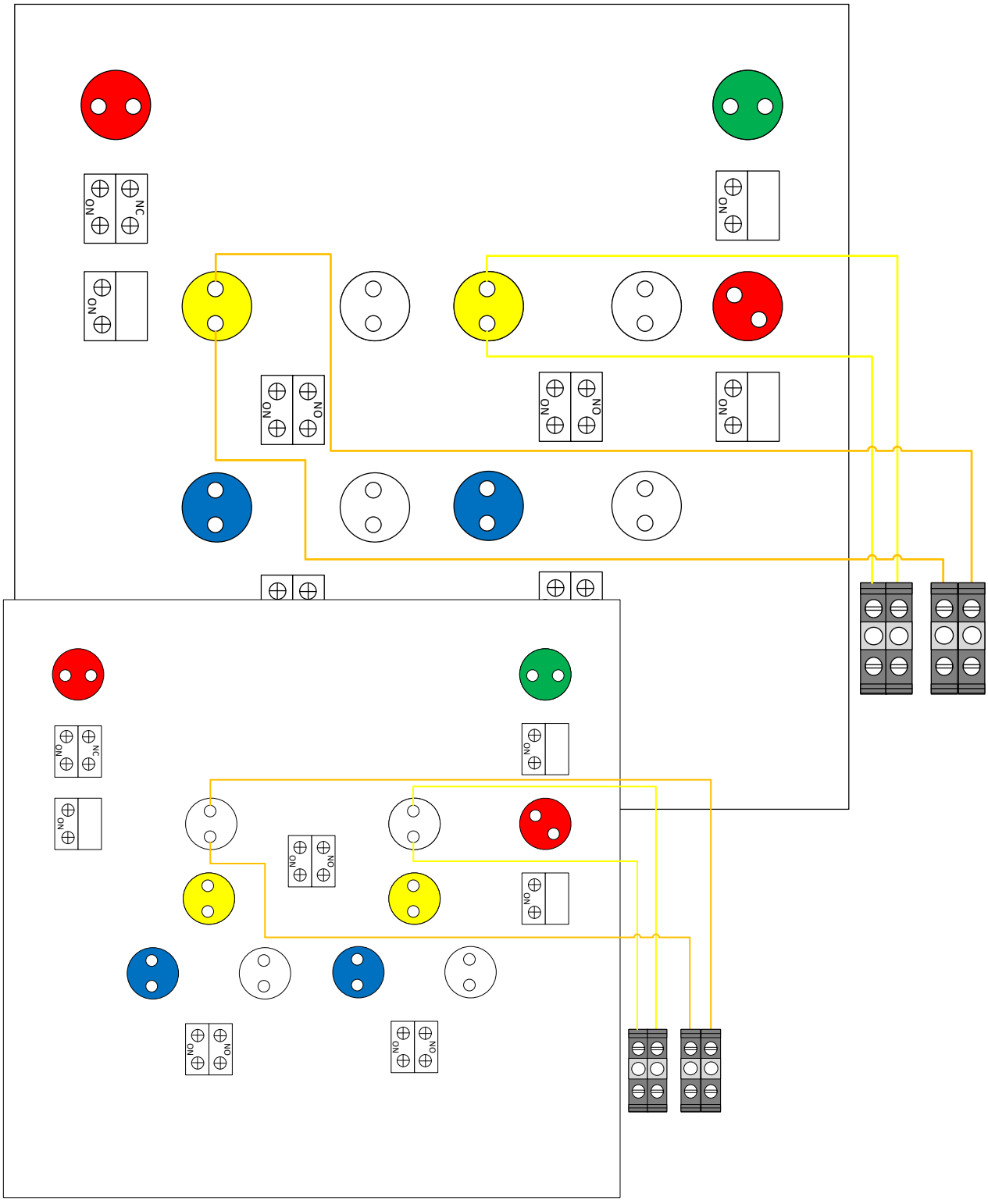
30a BCS 110v Common Wire up



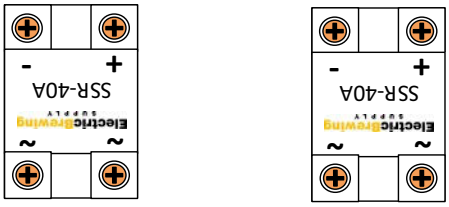
30a BCS 110v Common Wire up

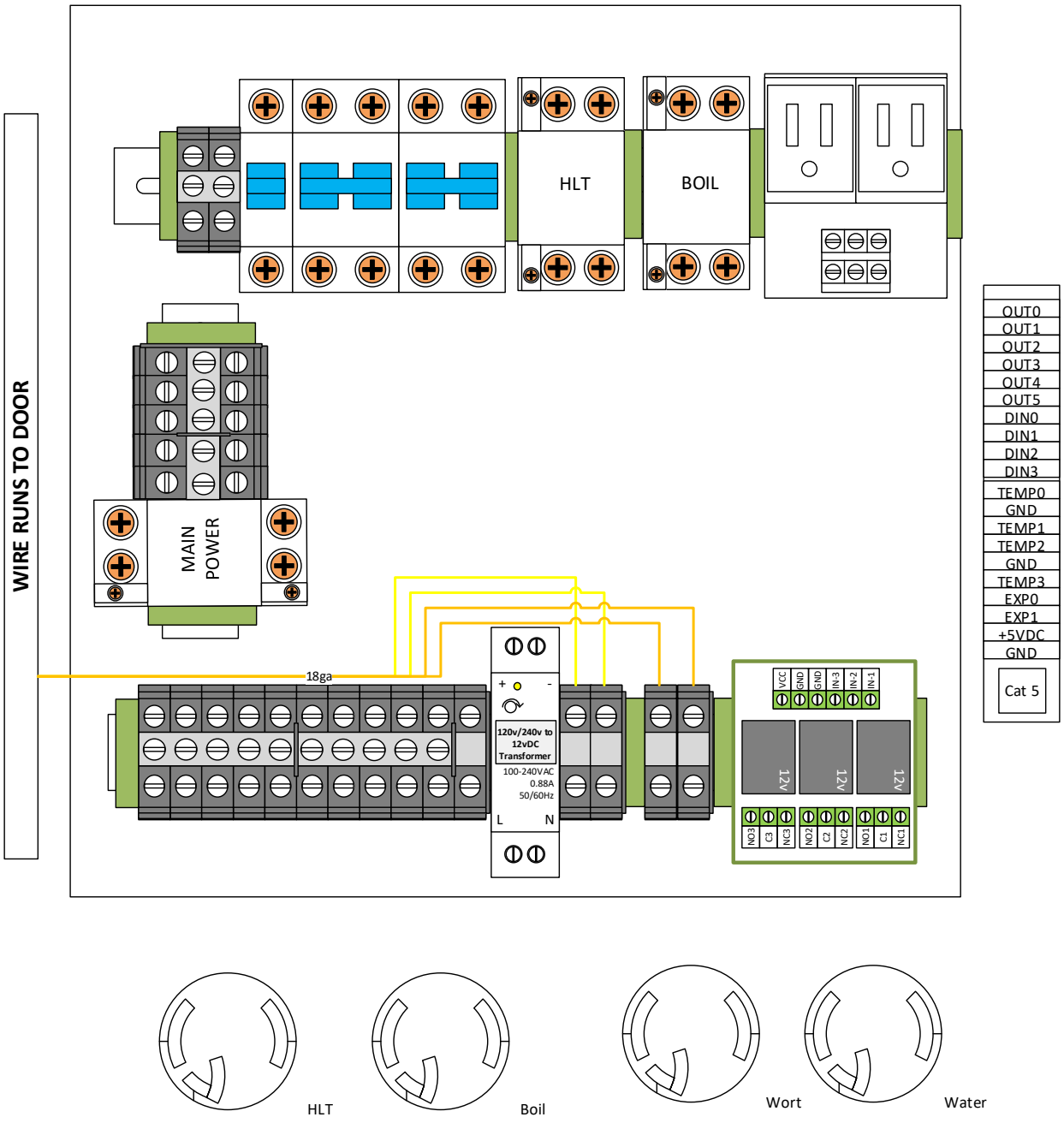


BCS Element LED Wire up

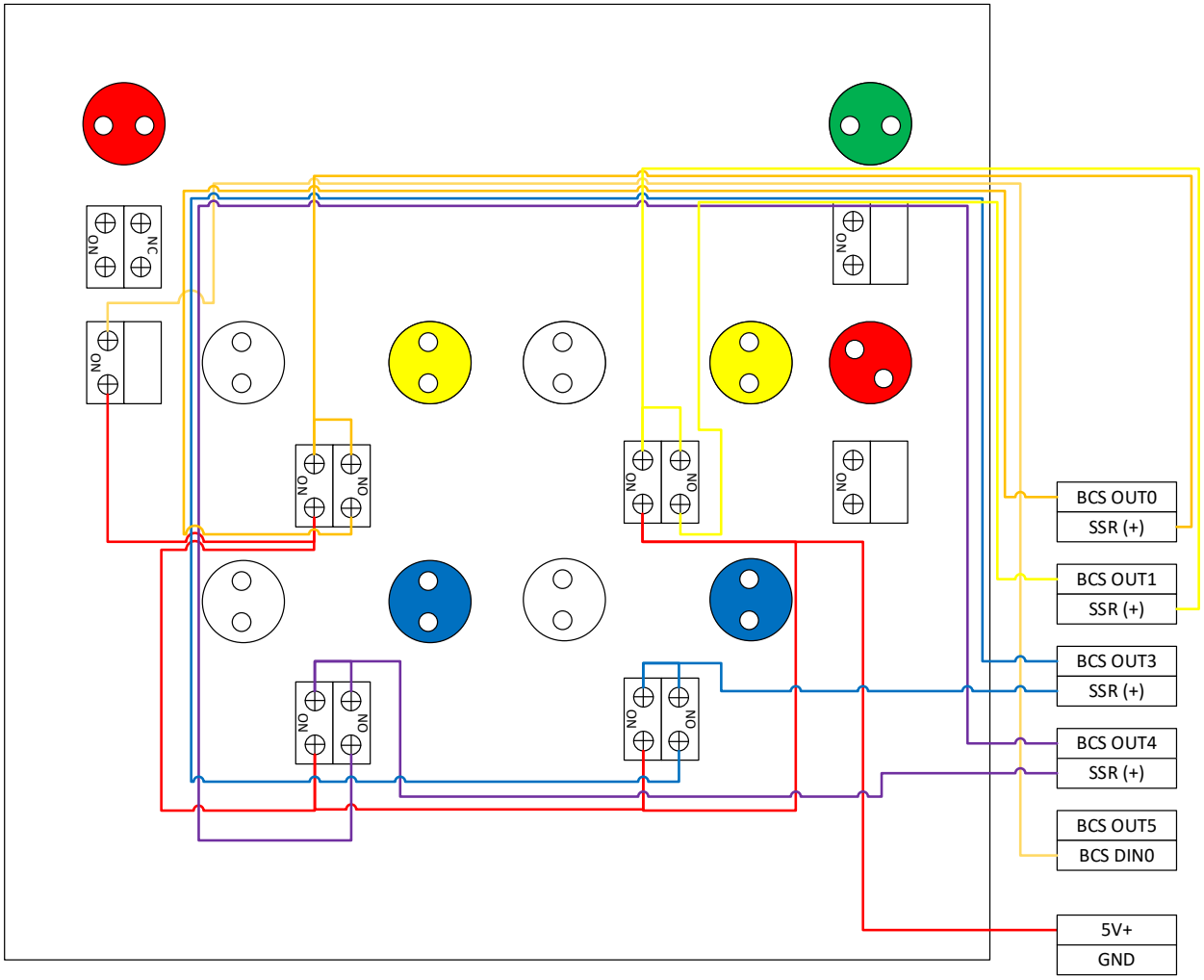


BCS Element LED wires

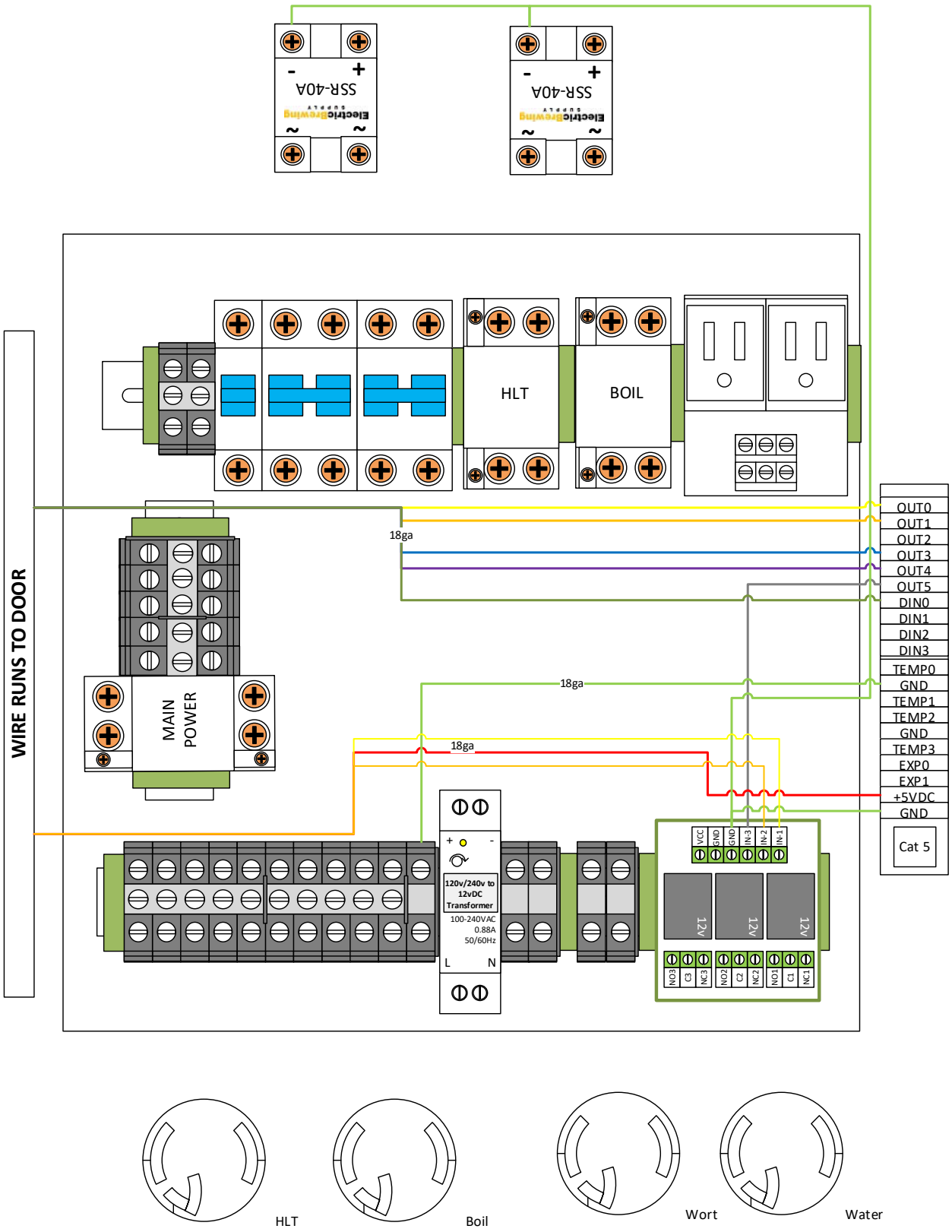




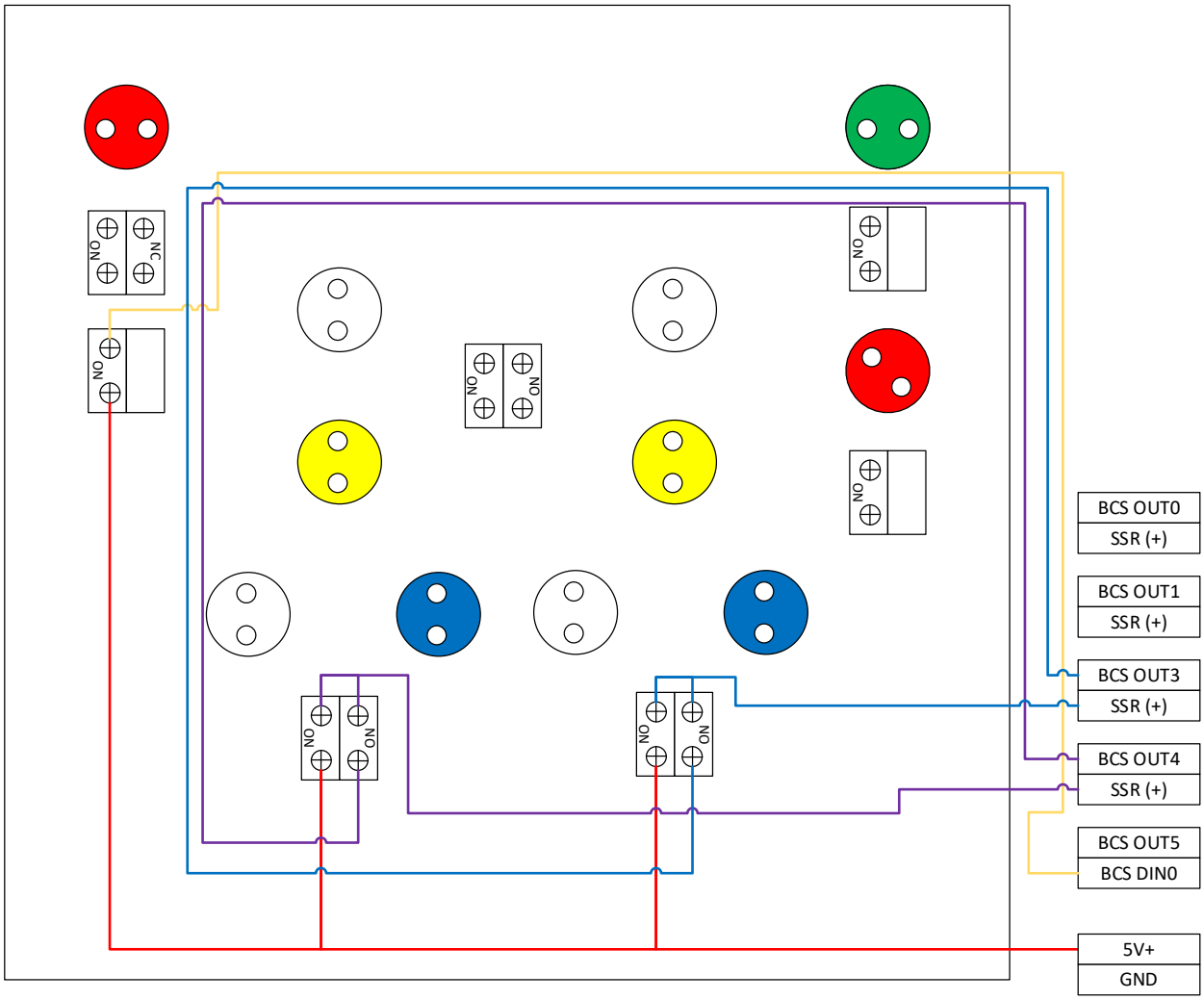
50a BCS Relay control wires on door side



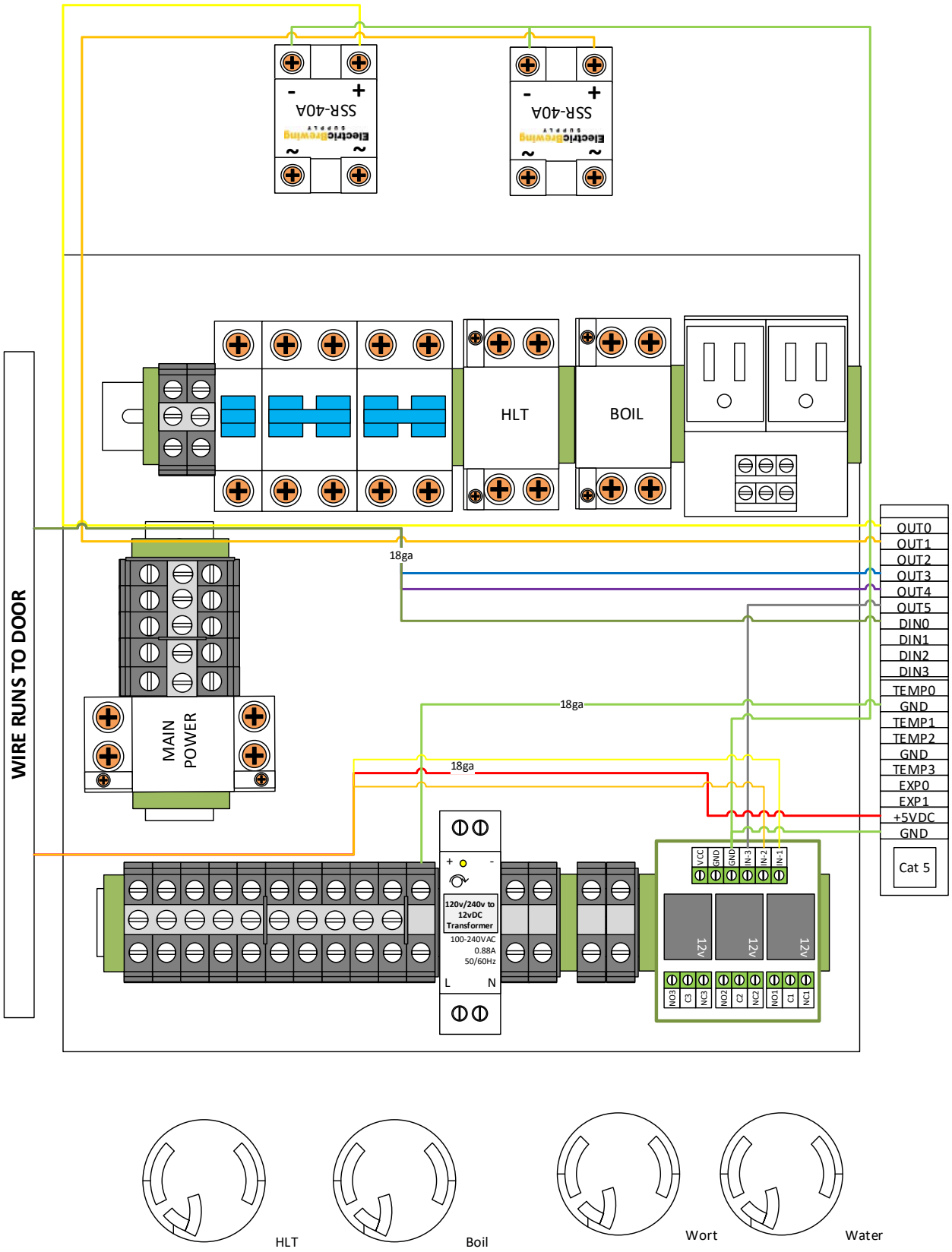
50a BCS Relay control wires inside enclosure



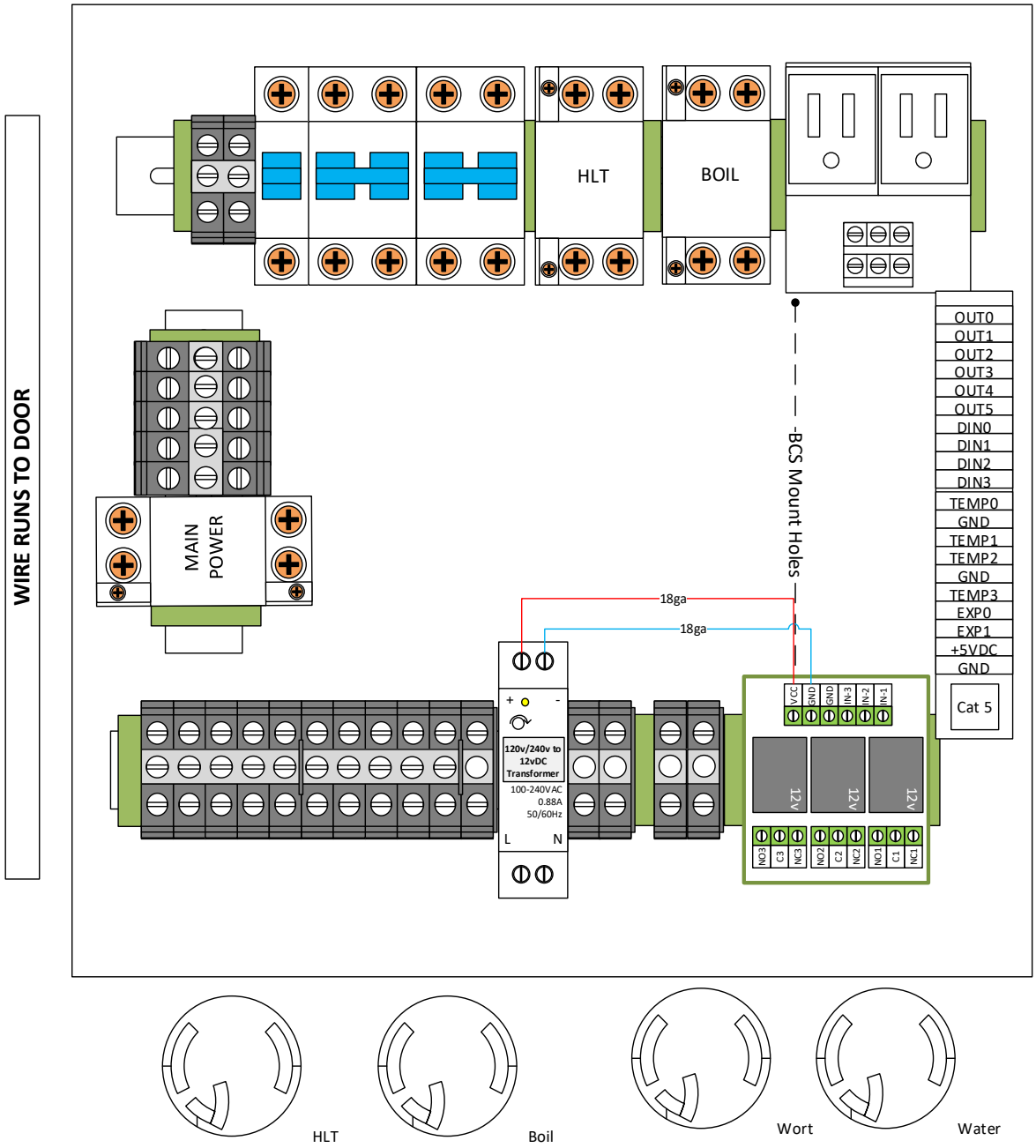
30a BCS Relay control wires on door side



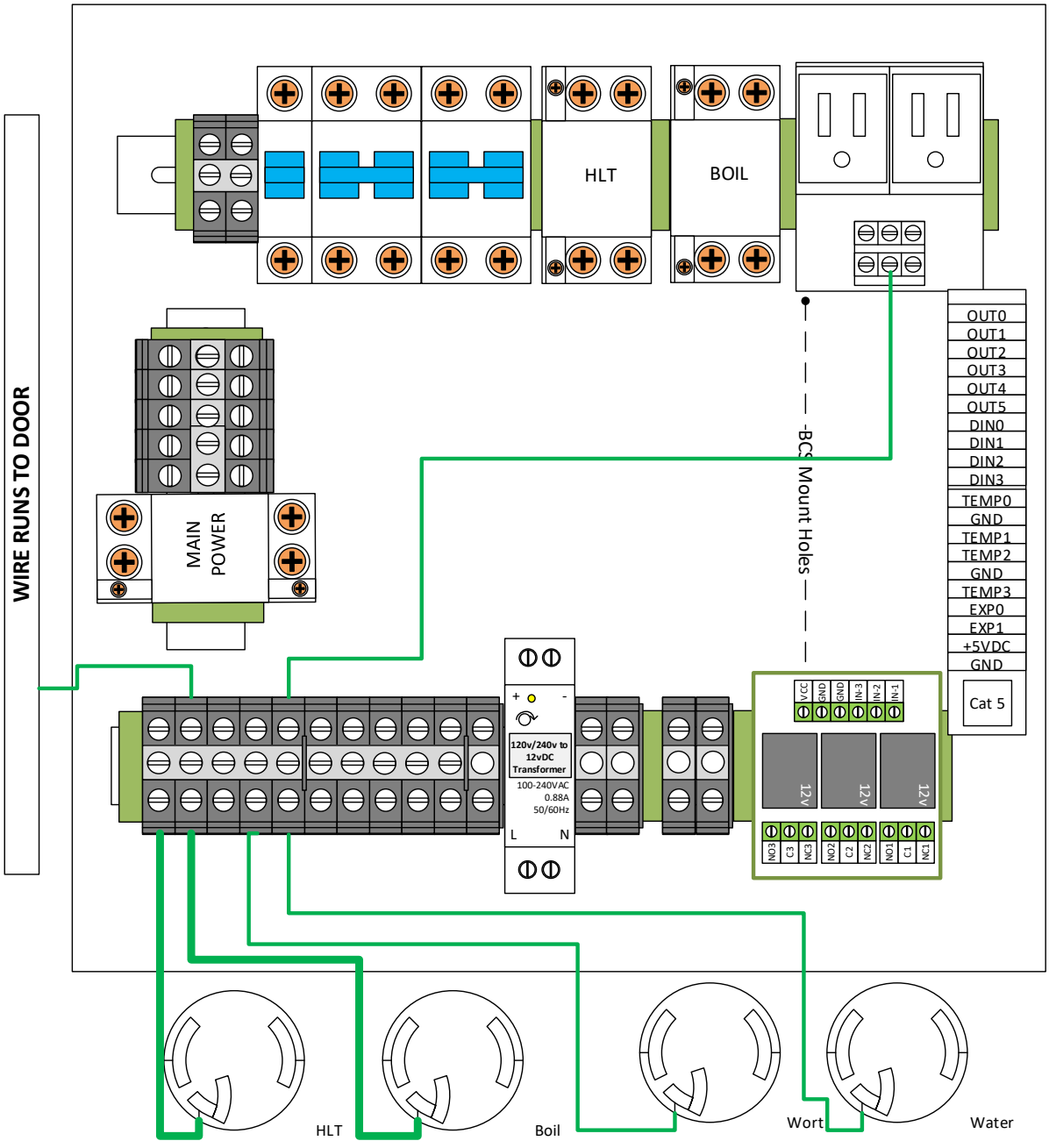
30a BCS Relay control wires inside enclosure



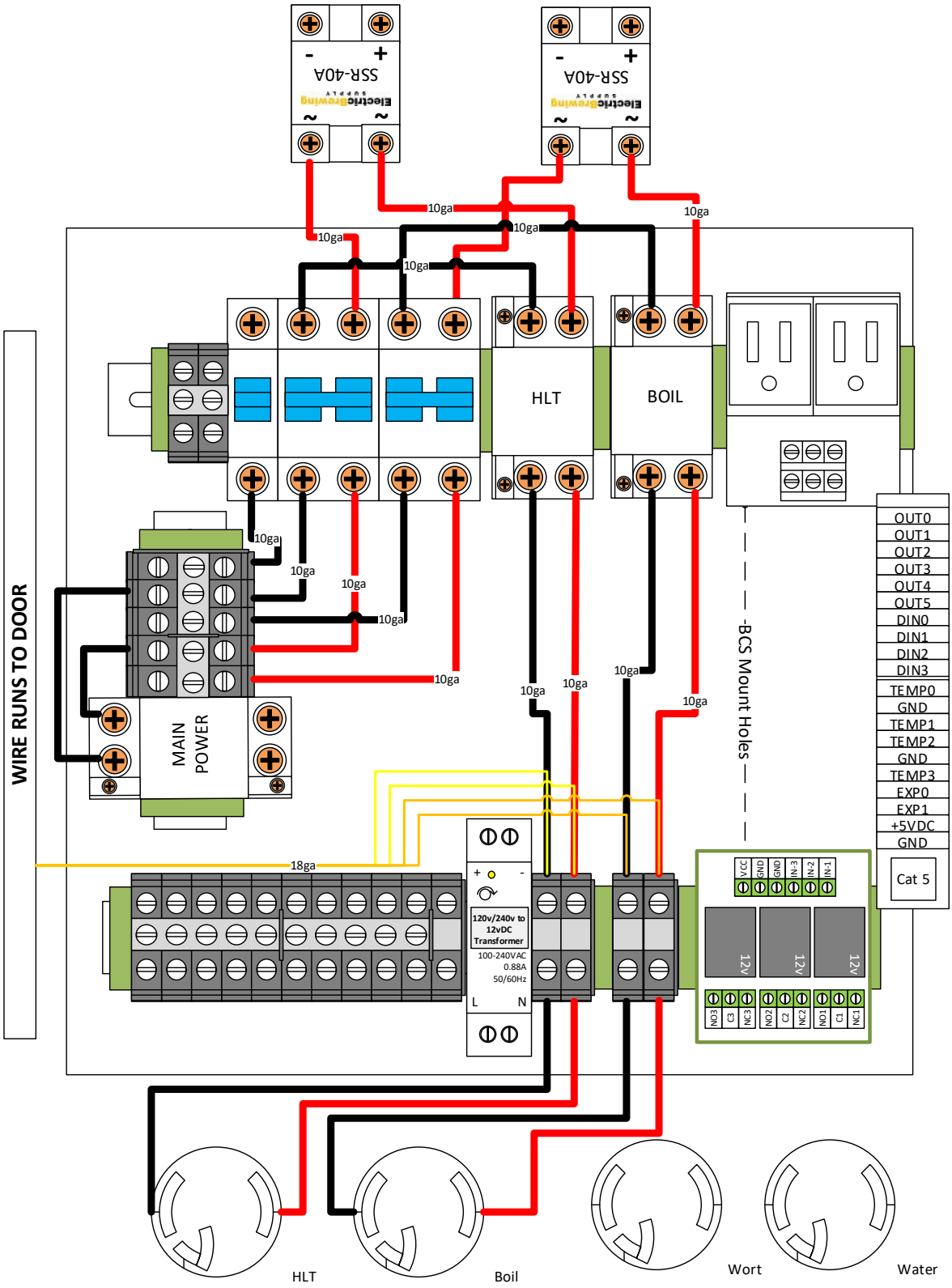
BCS 12v SPDT Wire Up



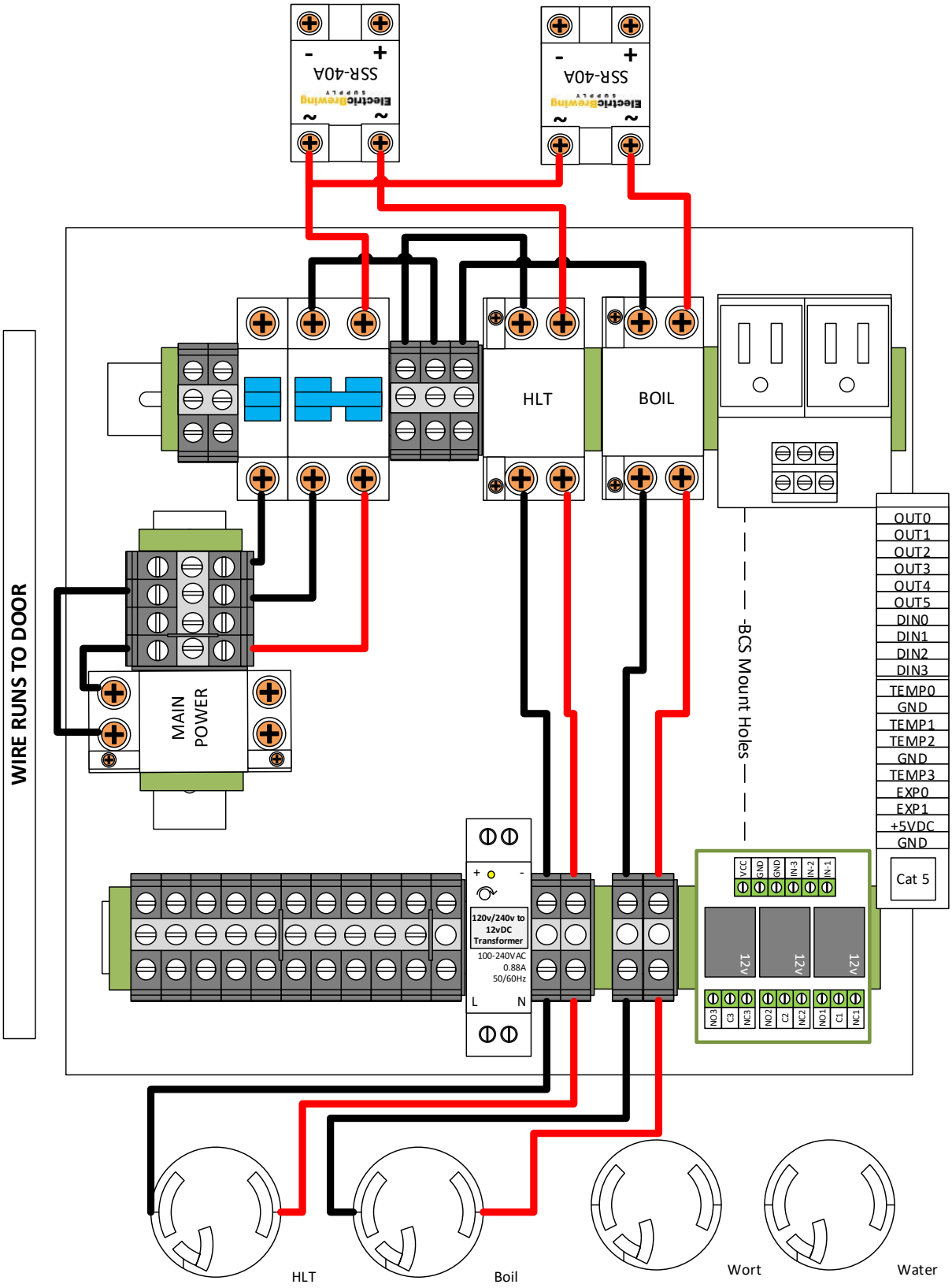
BCS Ground Wire Up



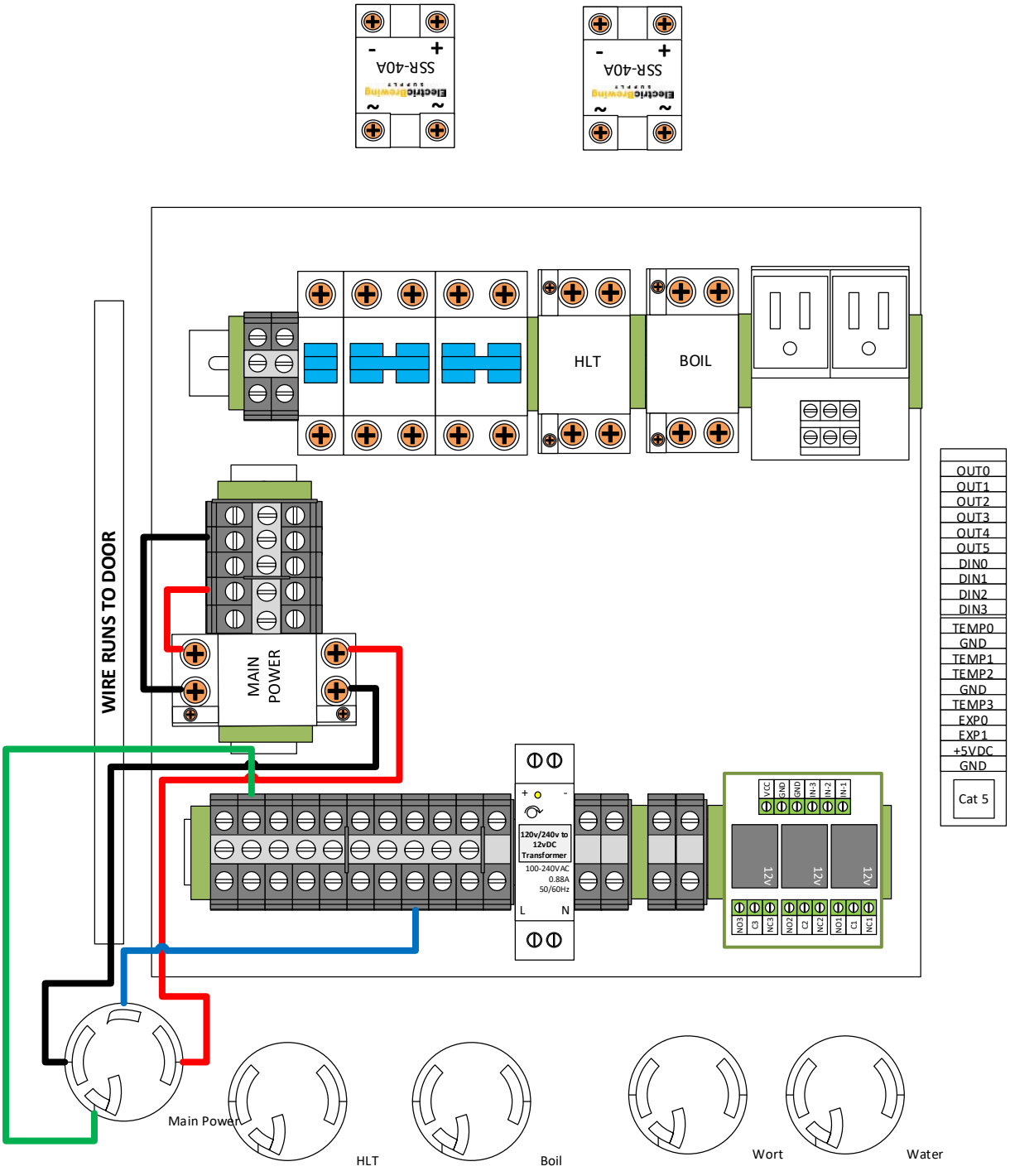
BCS 50a 220v Wire Up



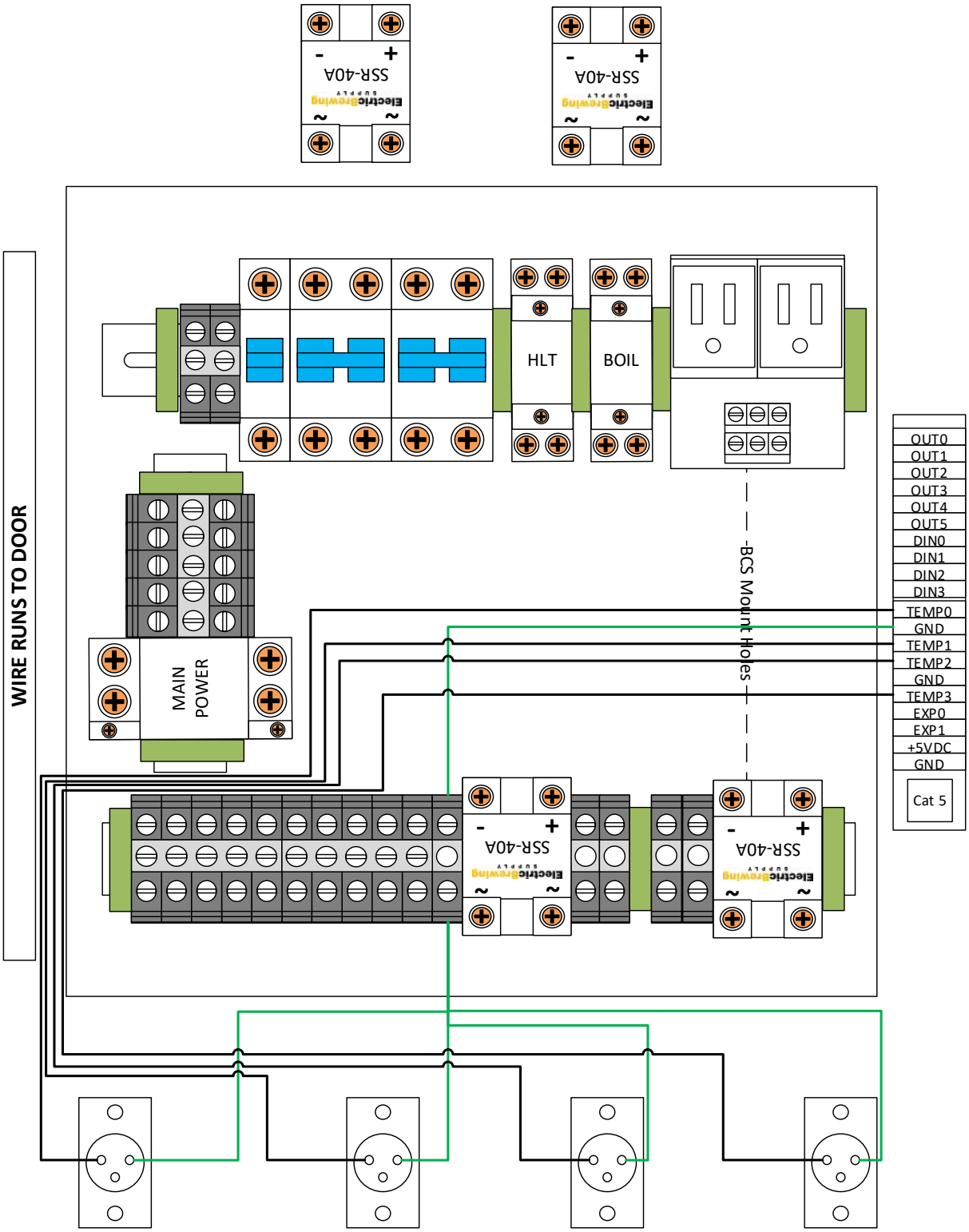
BCS 30a 220v Wire Up



Main Power Connection



BCS Temperature Probe XLR Wire up



By consolidating to a terminal block the wire up is easier. Additionally, adding the wire to the grounding cluster will stabilize temperature readings in your setup.

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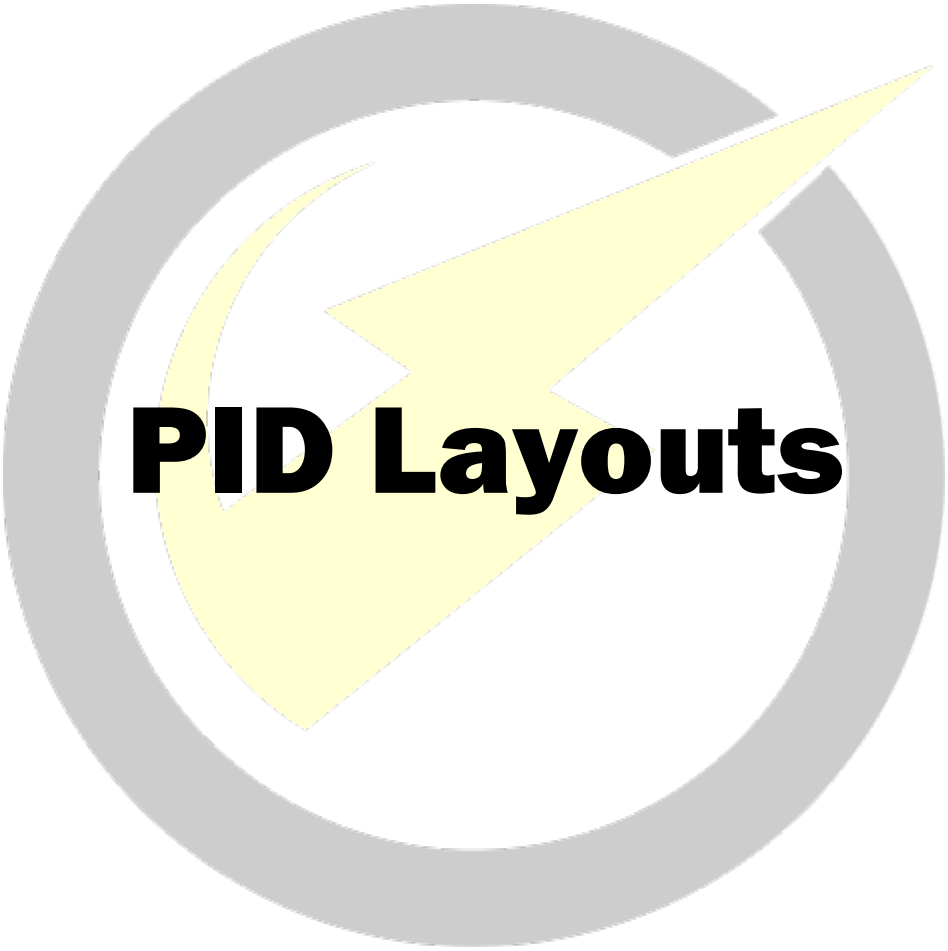
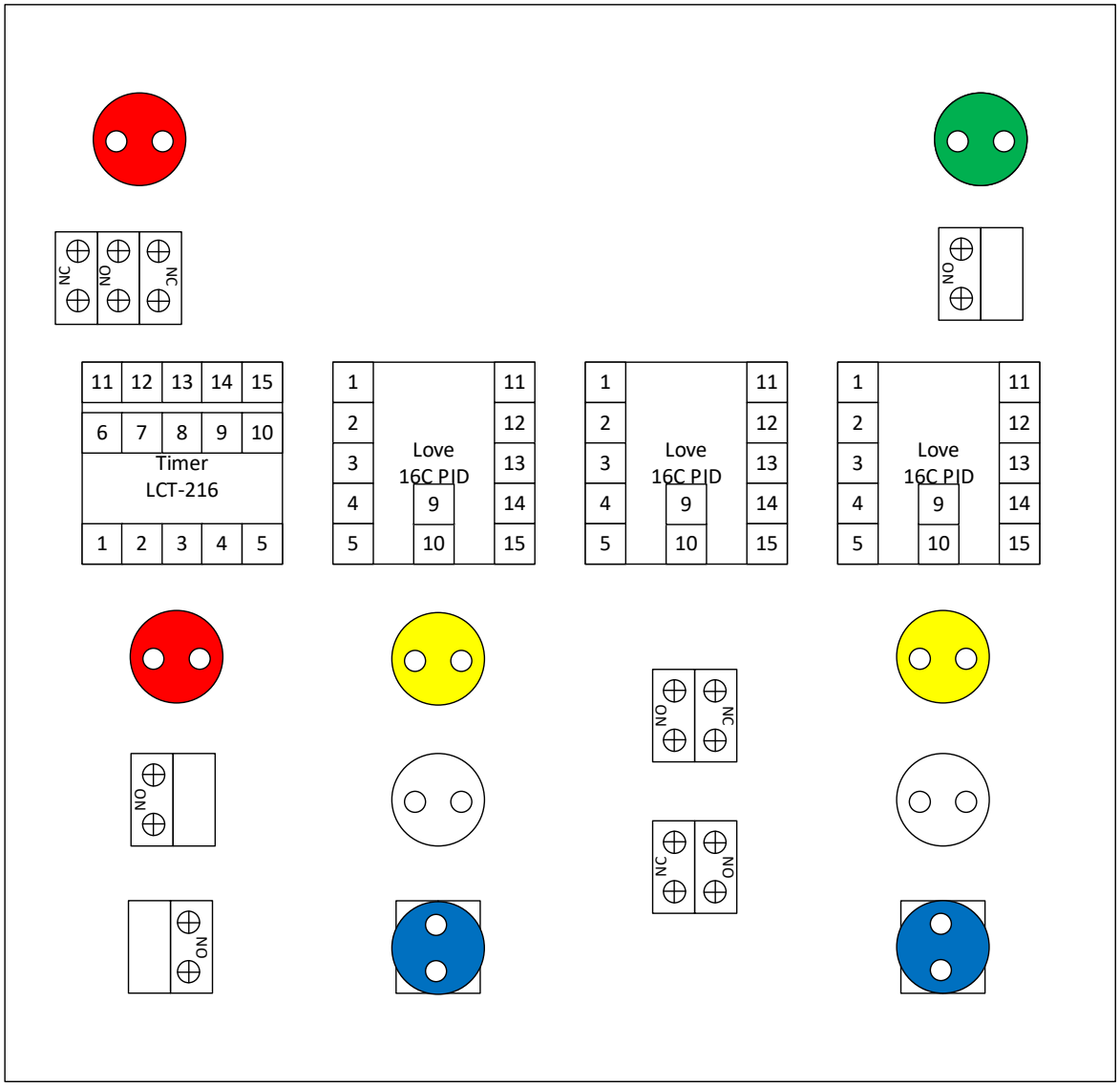


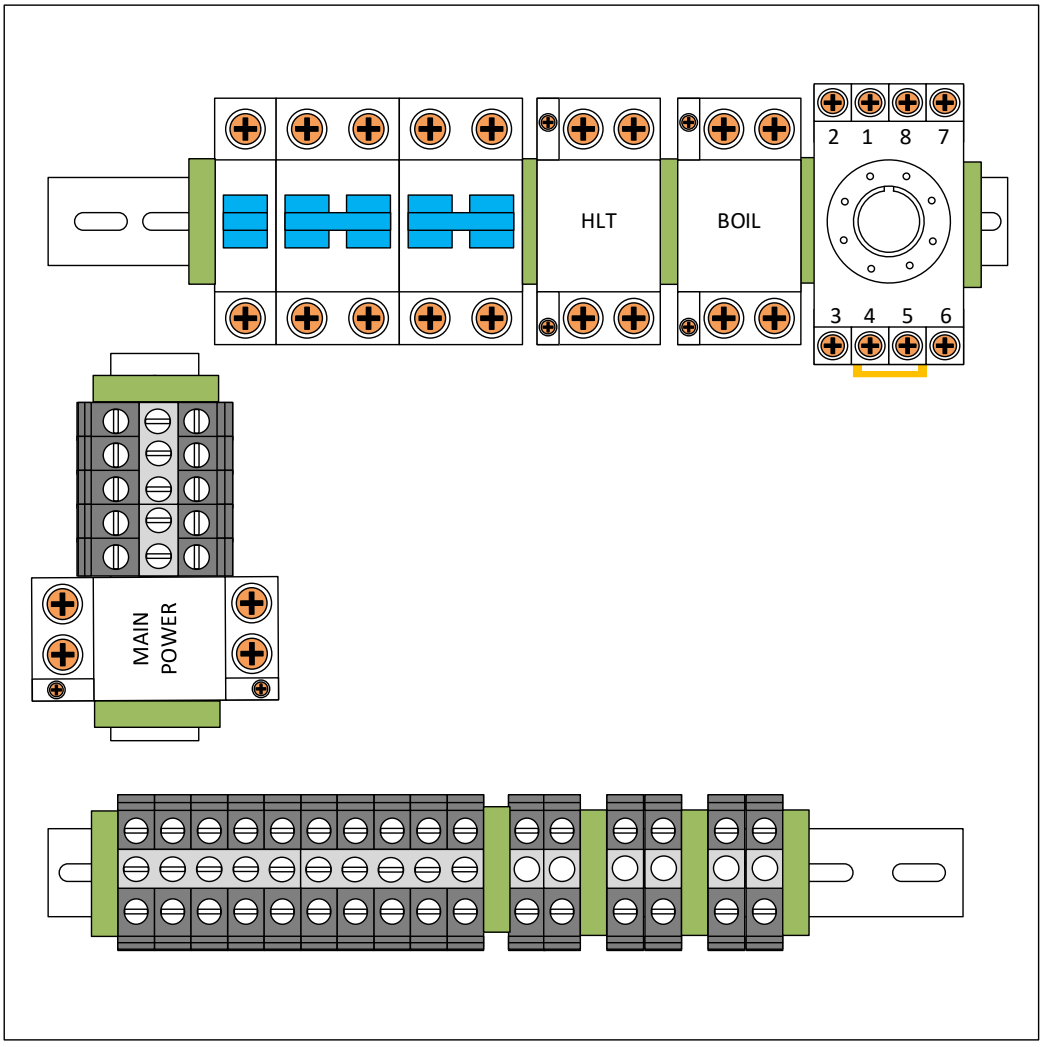
PID Layouts

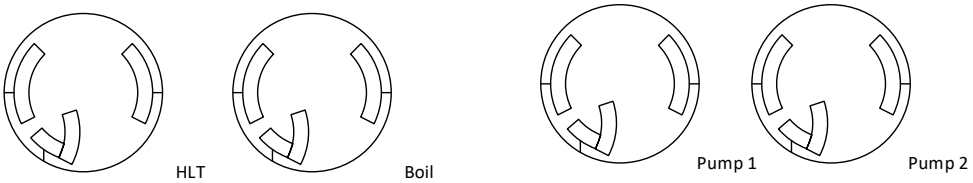
50a PID Layouts

In our base layout here, the pump switches are 2-way toggle led switches.

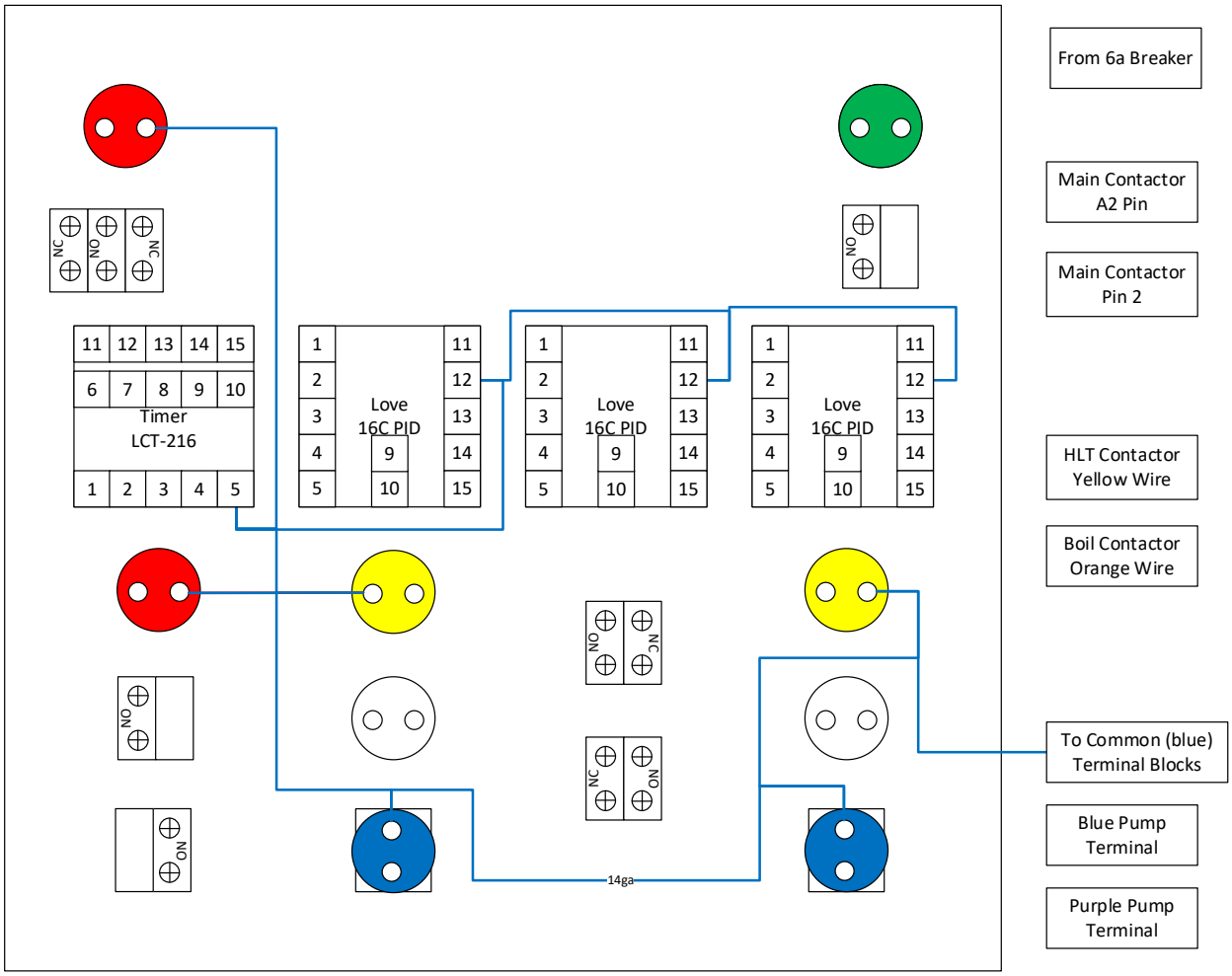


WIRE RUNS TO DOOR

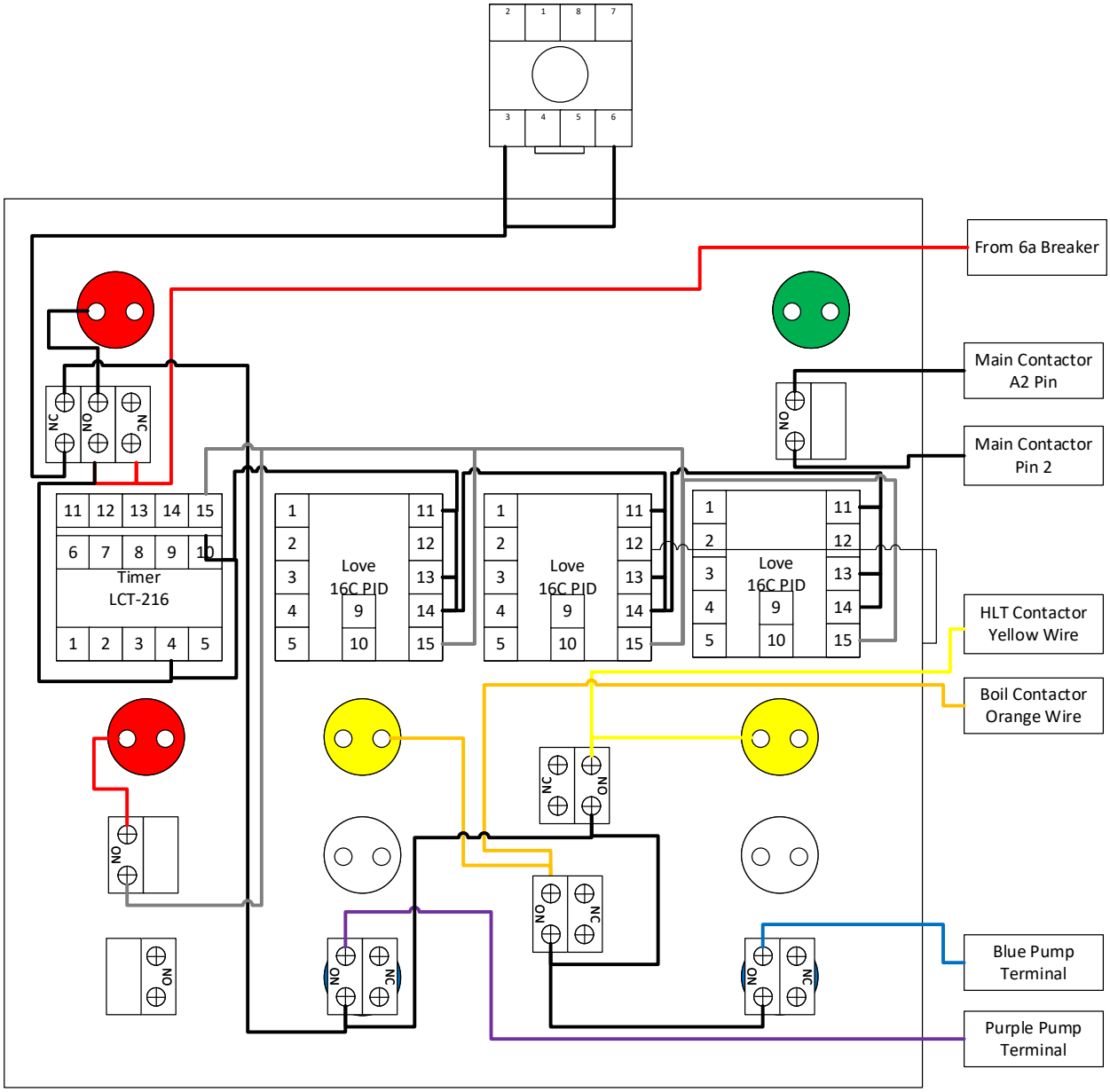




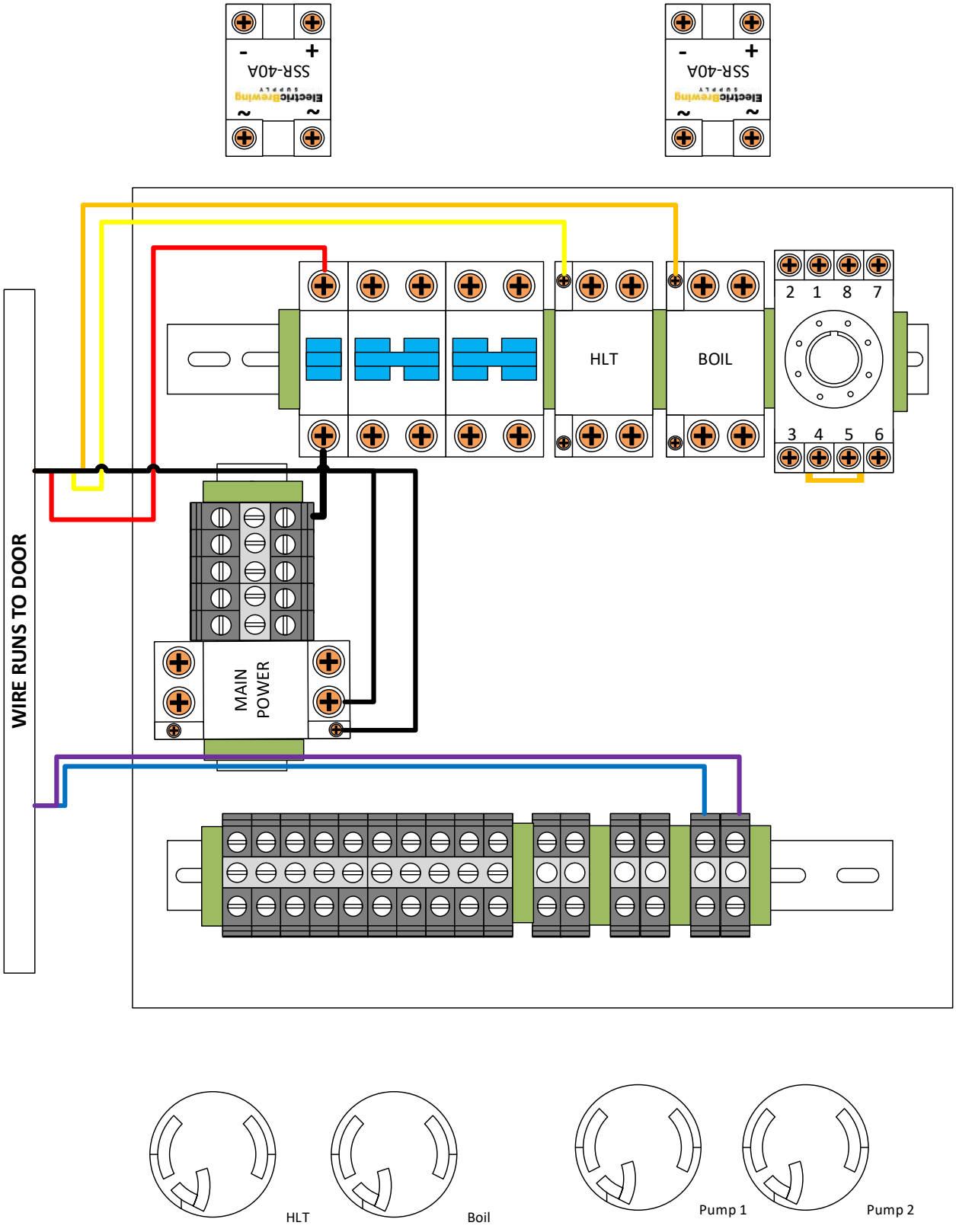
PID Door Common Wire up



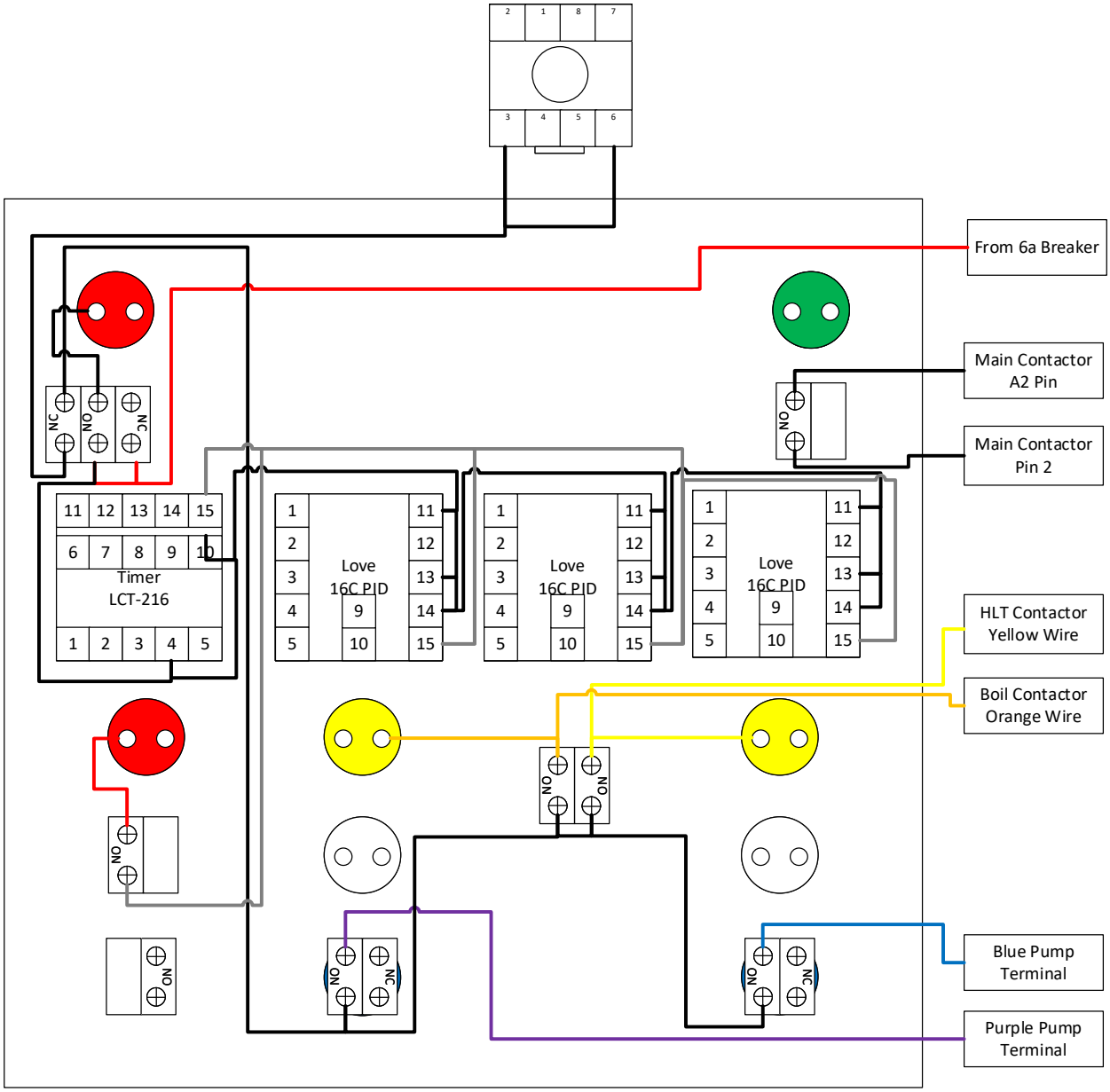
50a PID Door 110v Wire up



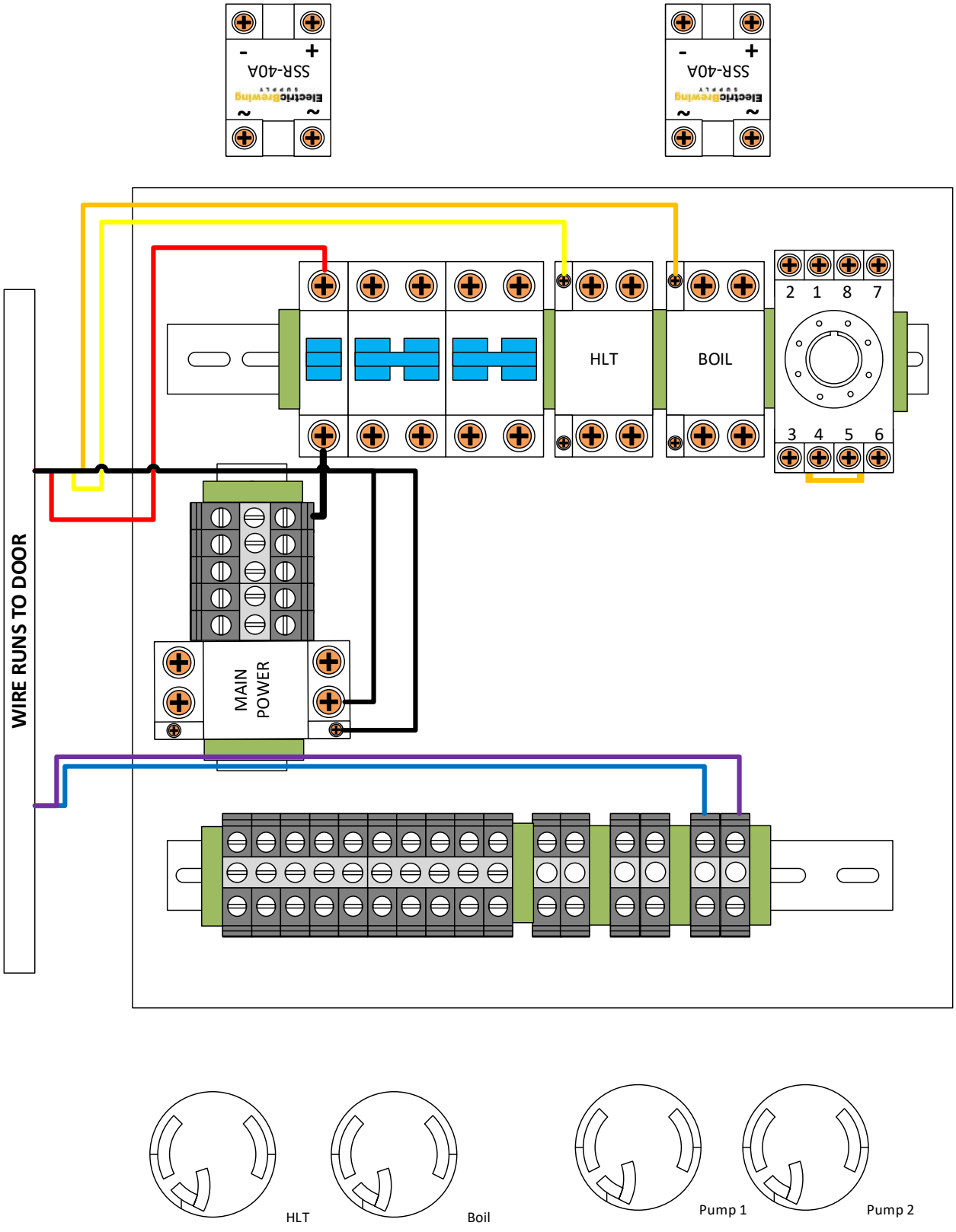
50a PID Sub Panel 110v Wire up



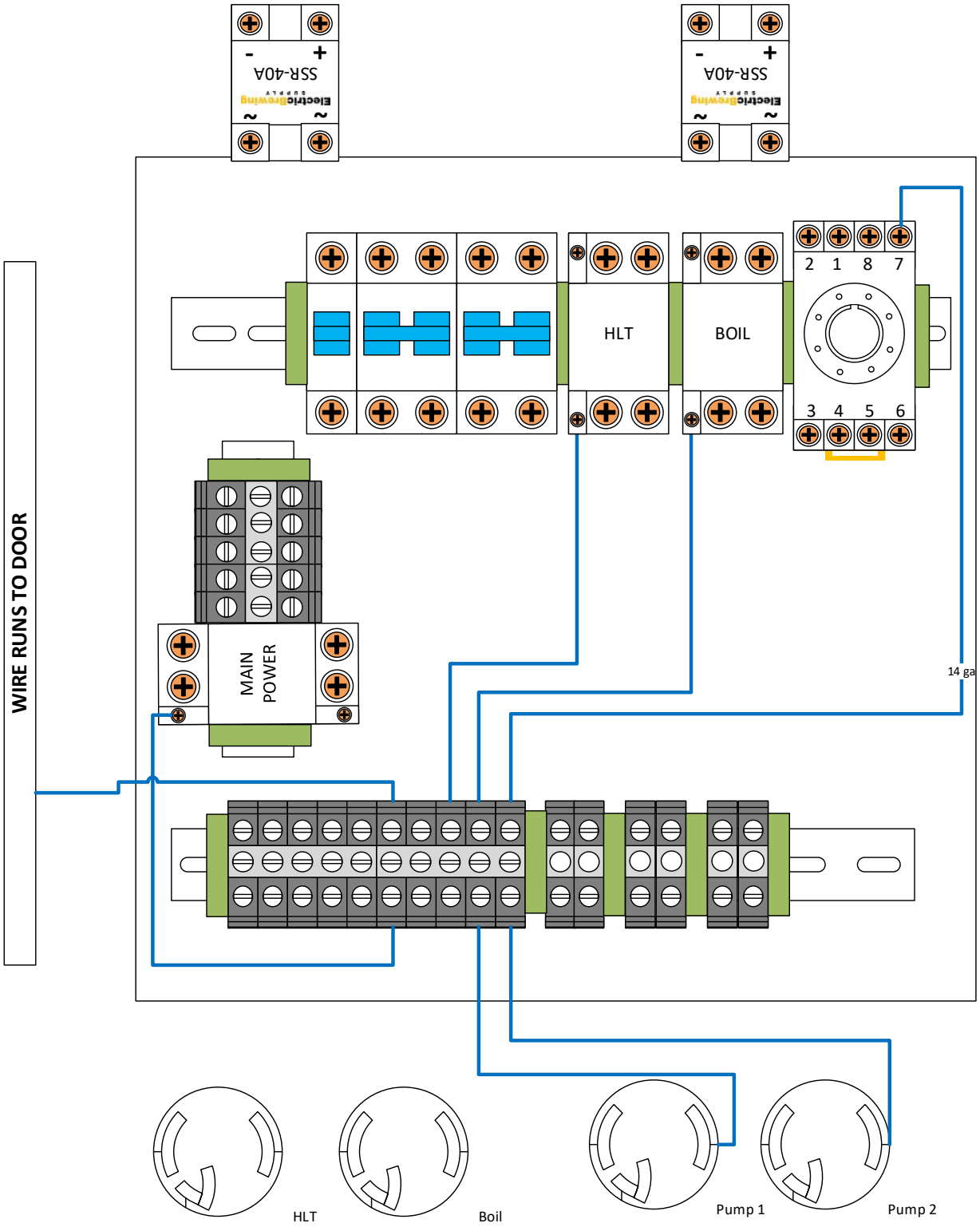
30a PID Door 110v Wire up



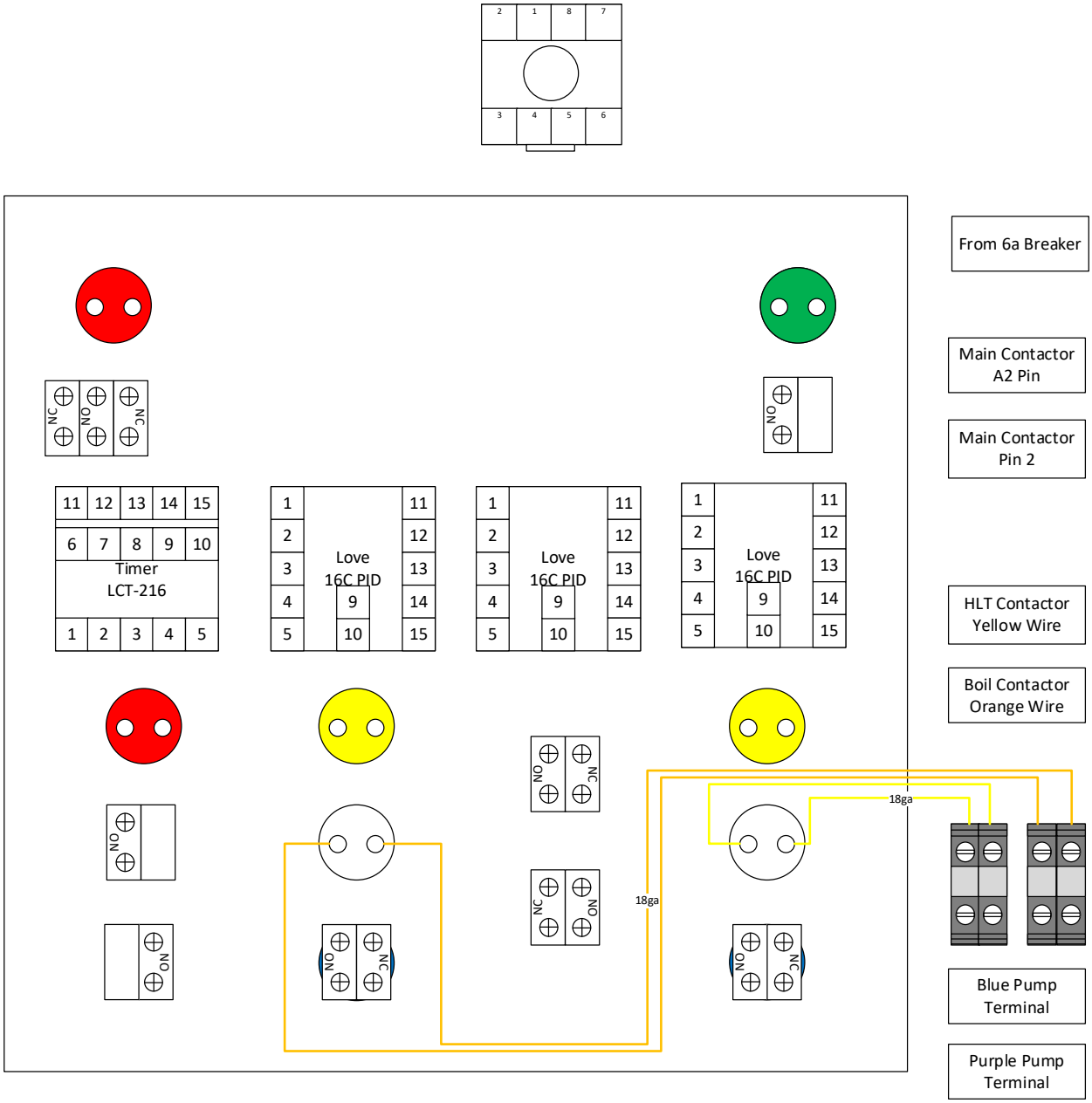
30a PID Sub Panel 110v Wire up



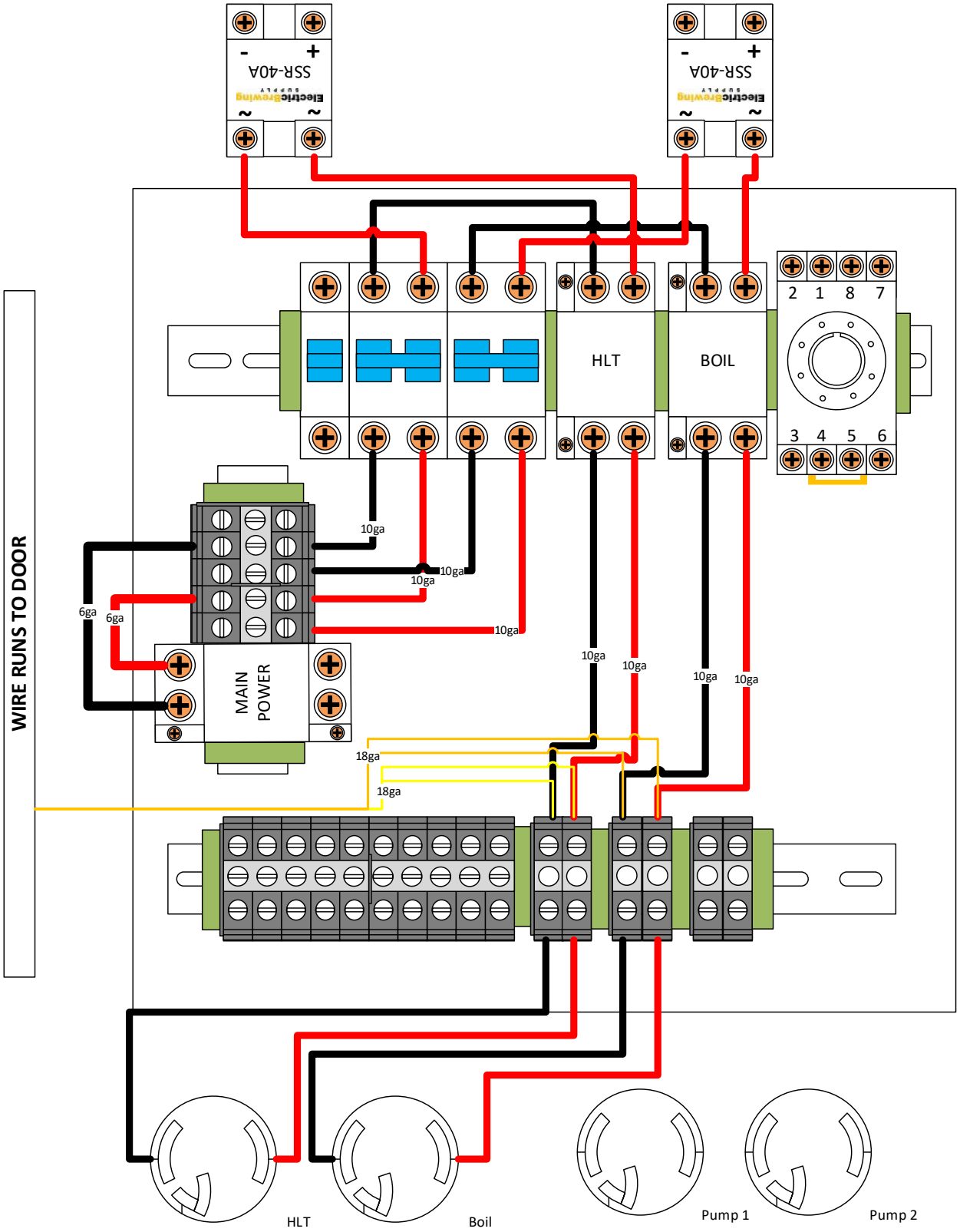
PID Common Wire Up



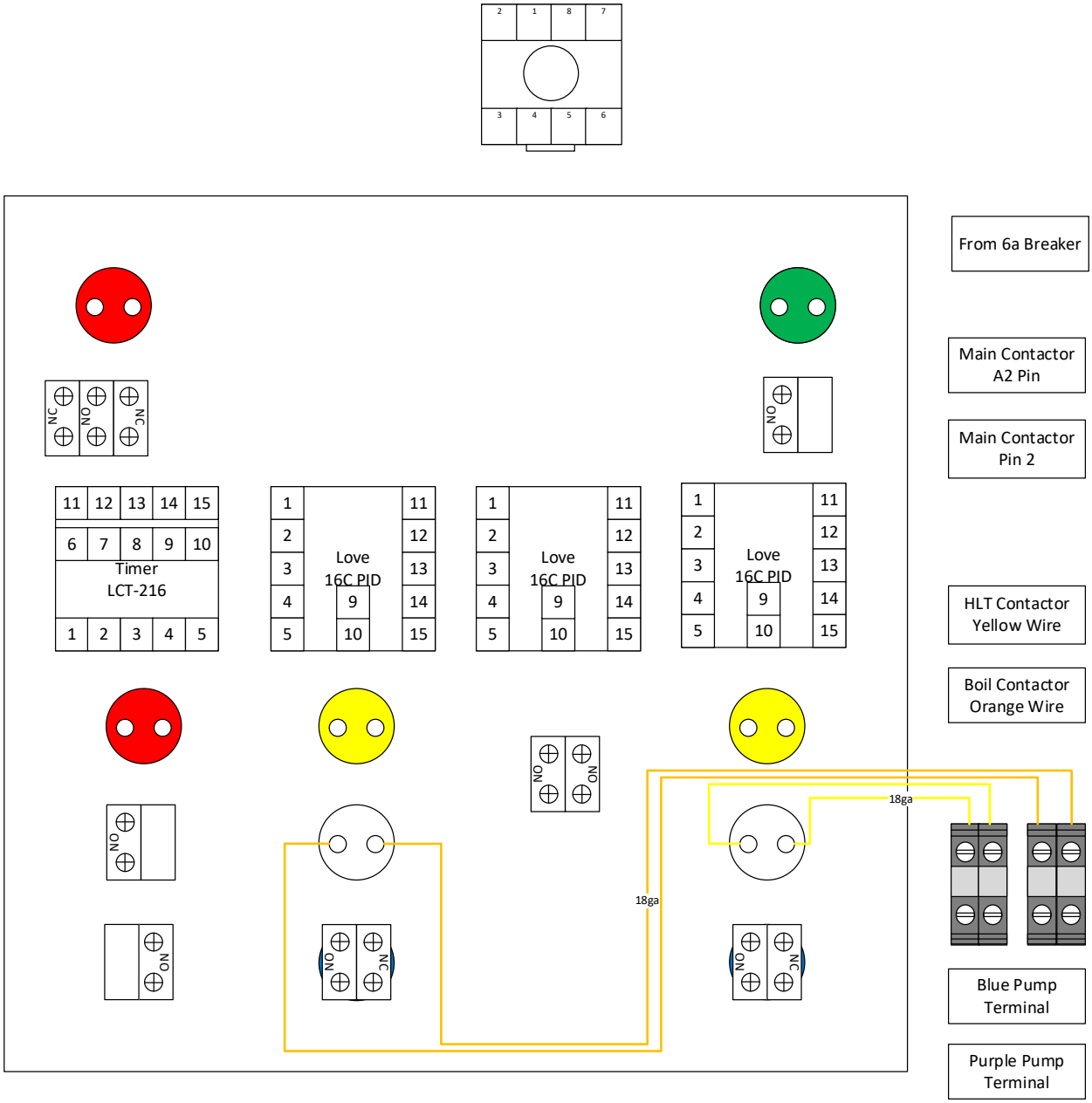
PID 50a 220v Door Wiring



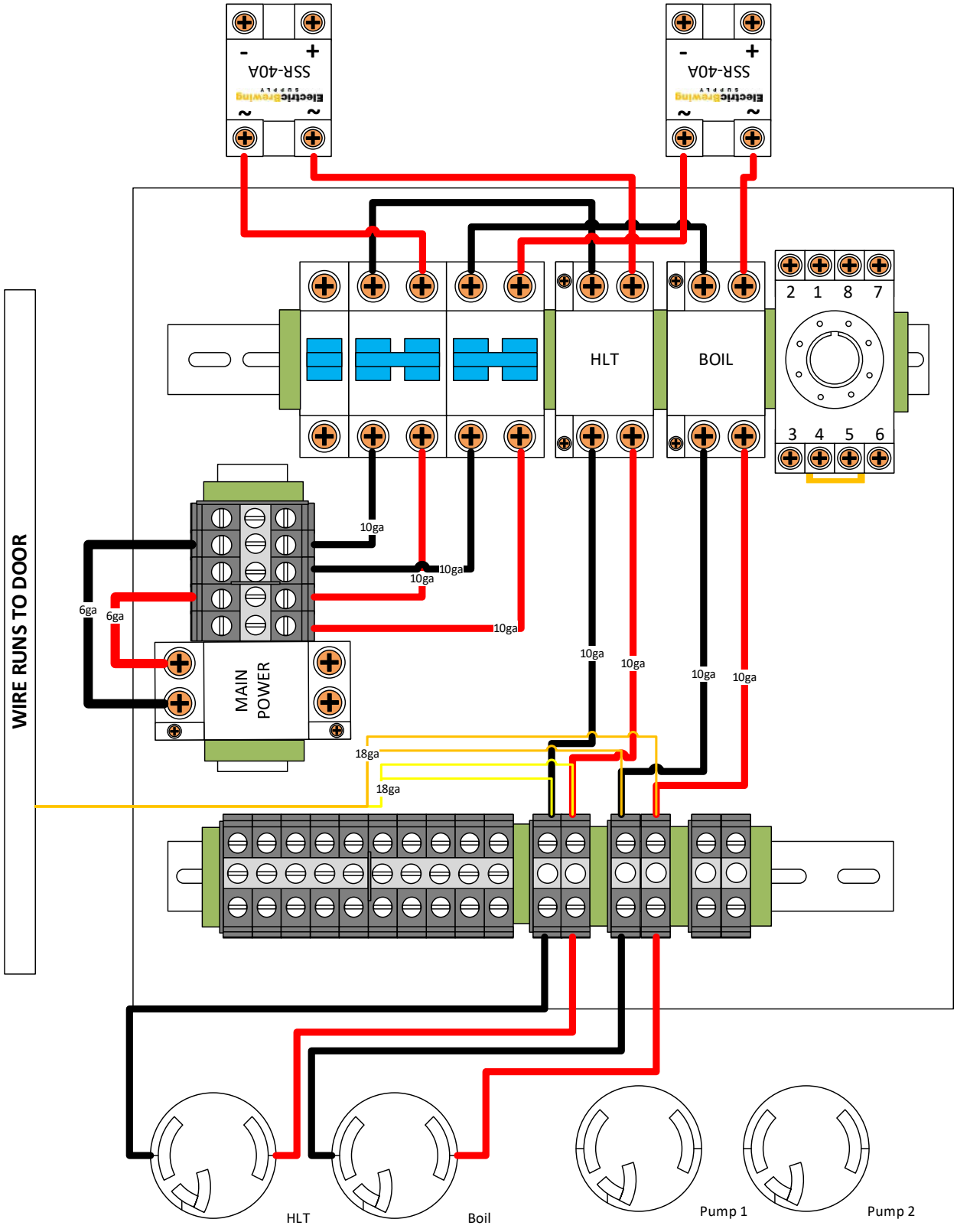
PID 50a 220v Sub Panel Wiring



PID 30a 220v Door Wiring

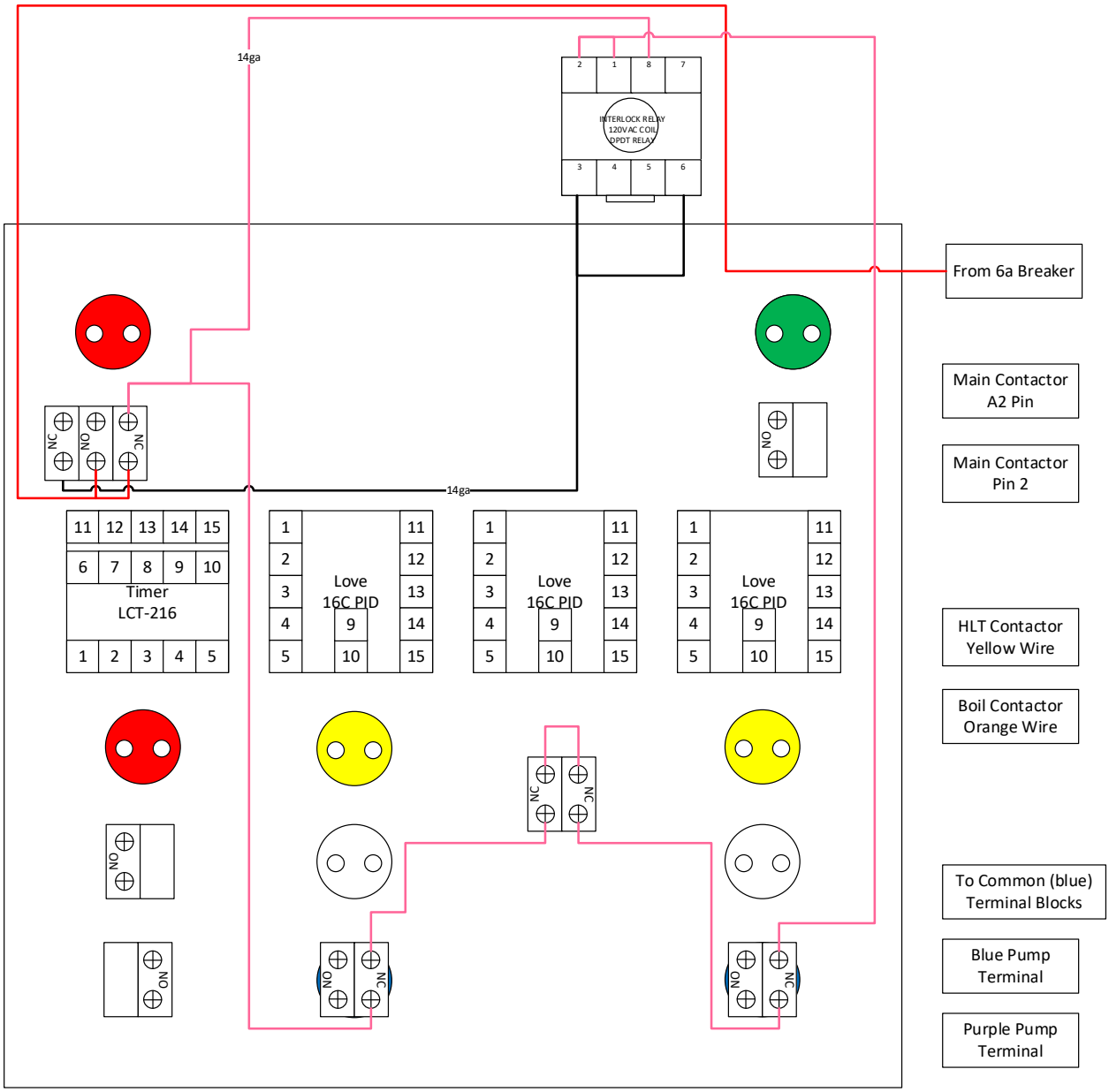


PID 30a 220v Sub Panel Wiring



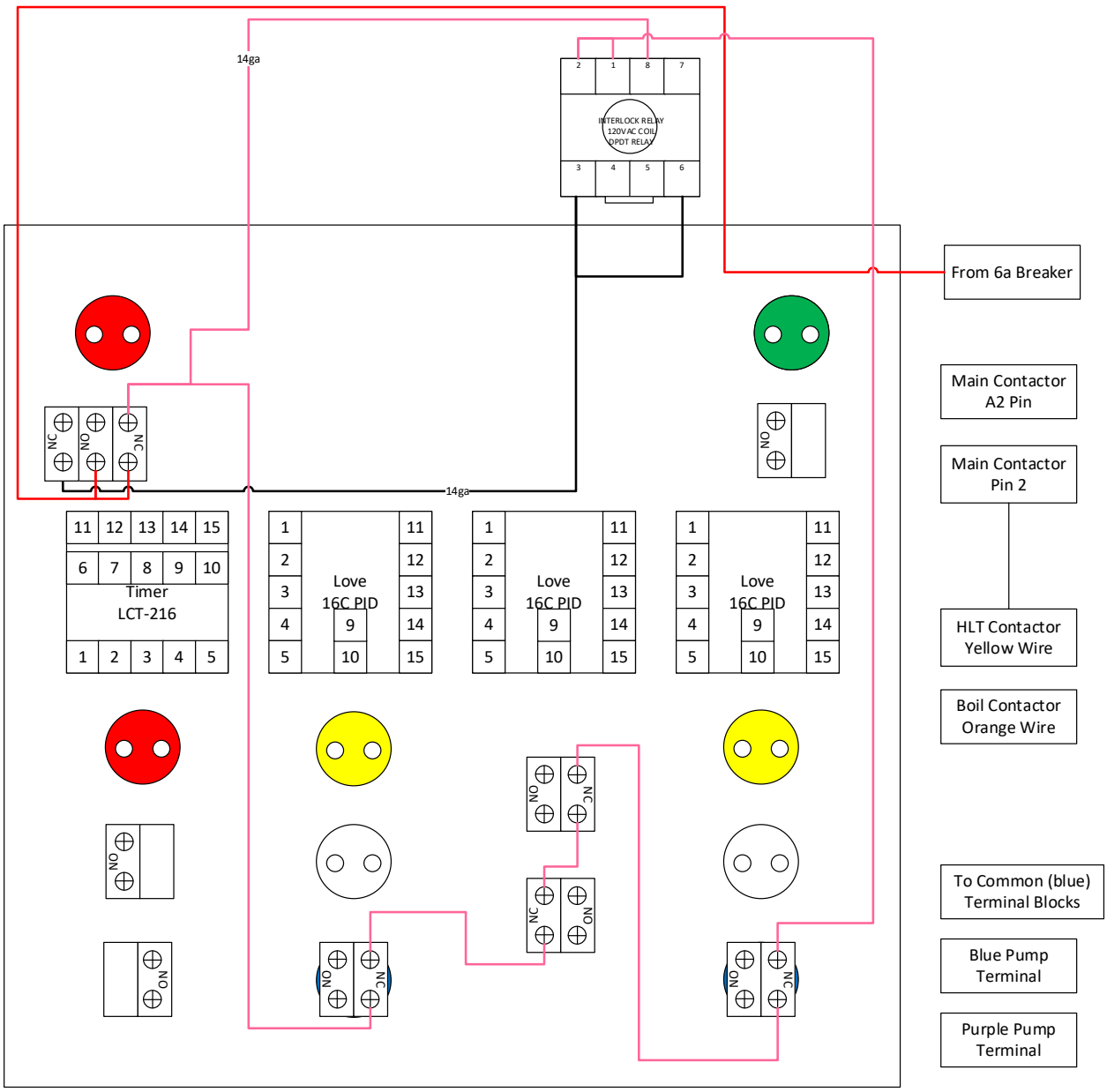
30a PID Protective Relay Circuit

This circuit is key, if either a pump or element switch is left on when the e-stop or key switch are turned on, the element/pump circuit will not come on; only the PIDs and alarms will power.

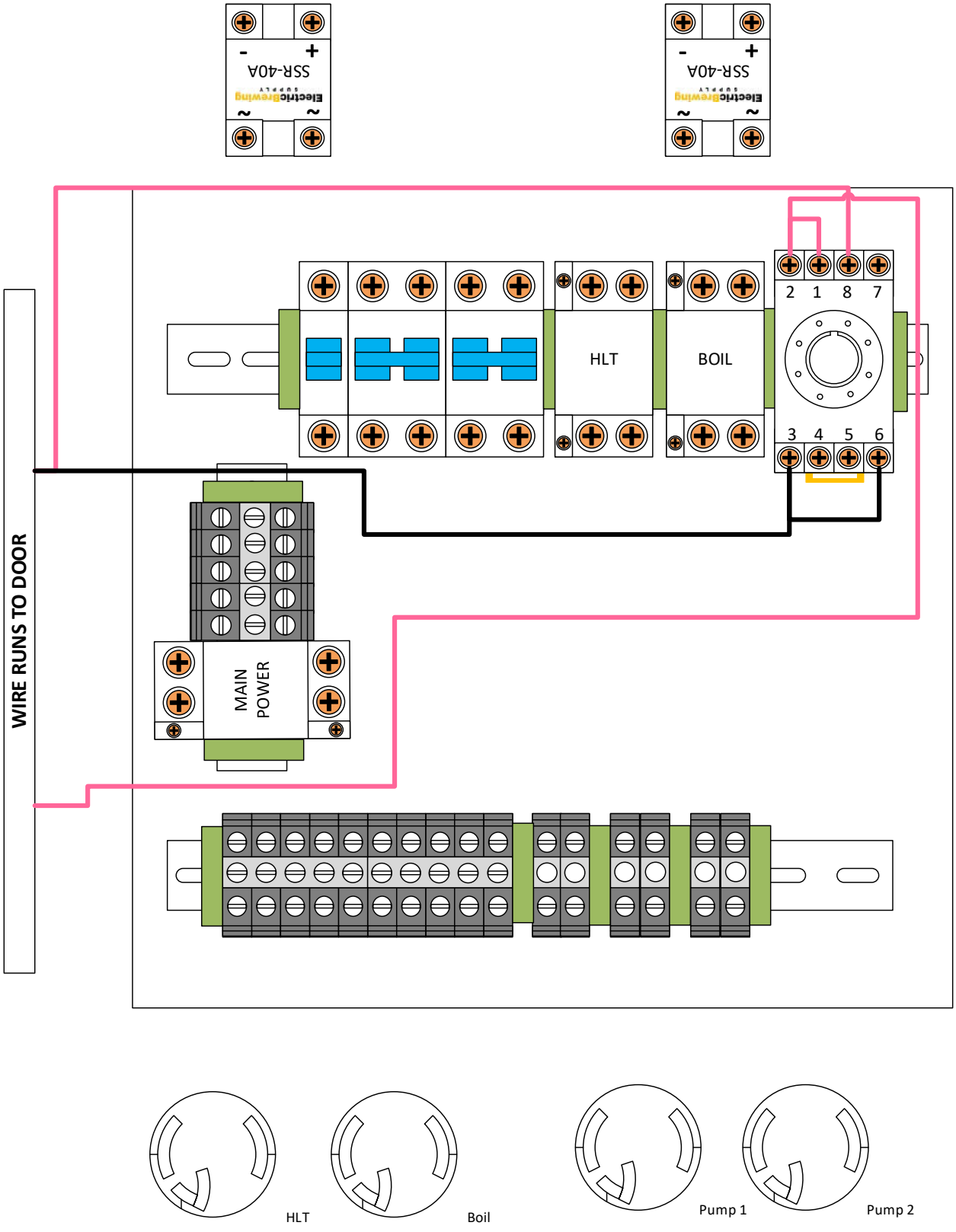


It is also important to note that PIN 8 from the relay goes directly to the e-stop NO Block.

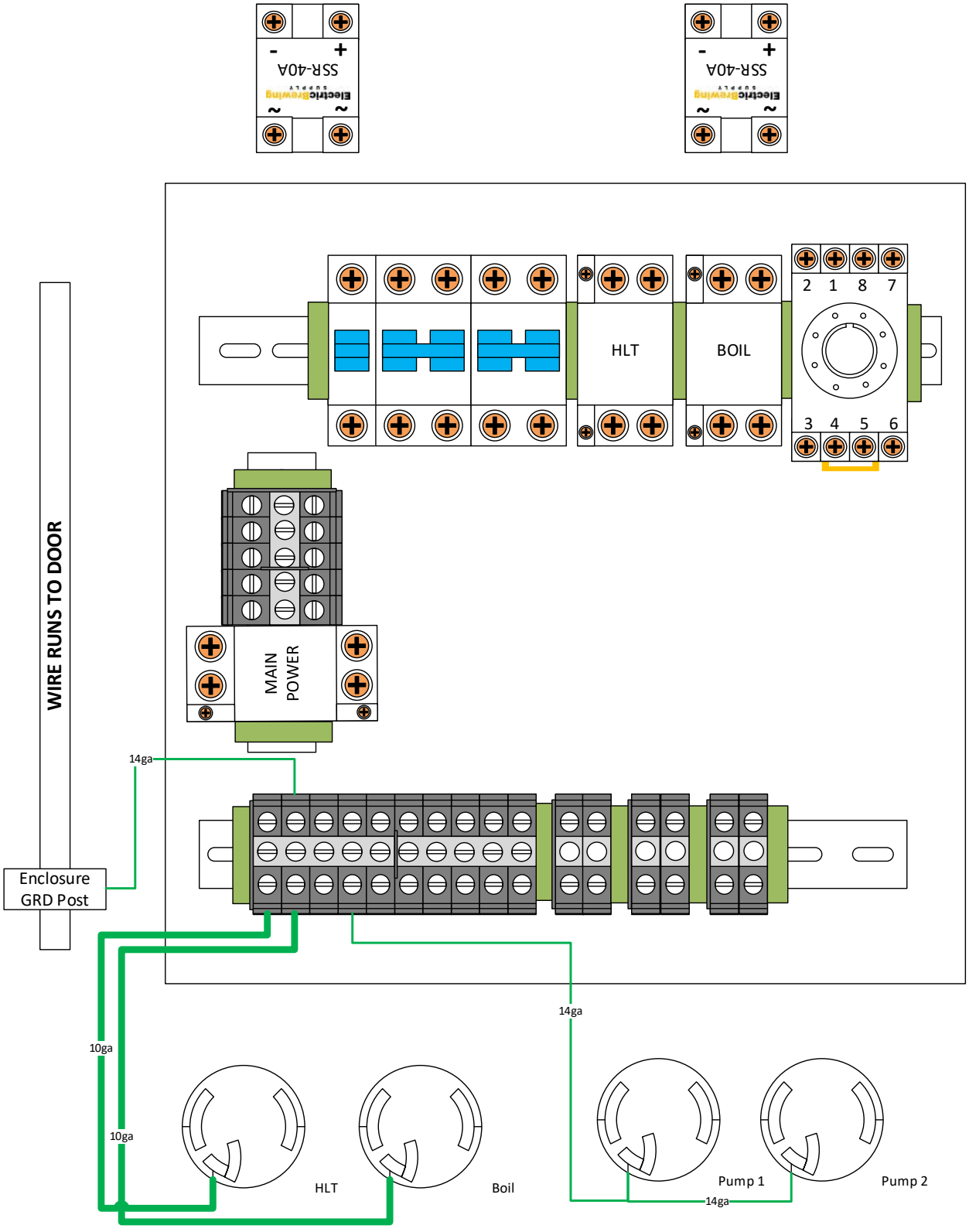
50a PID Protective Relay Circuit



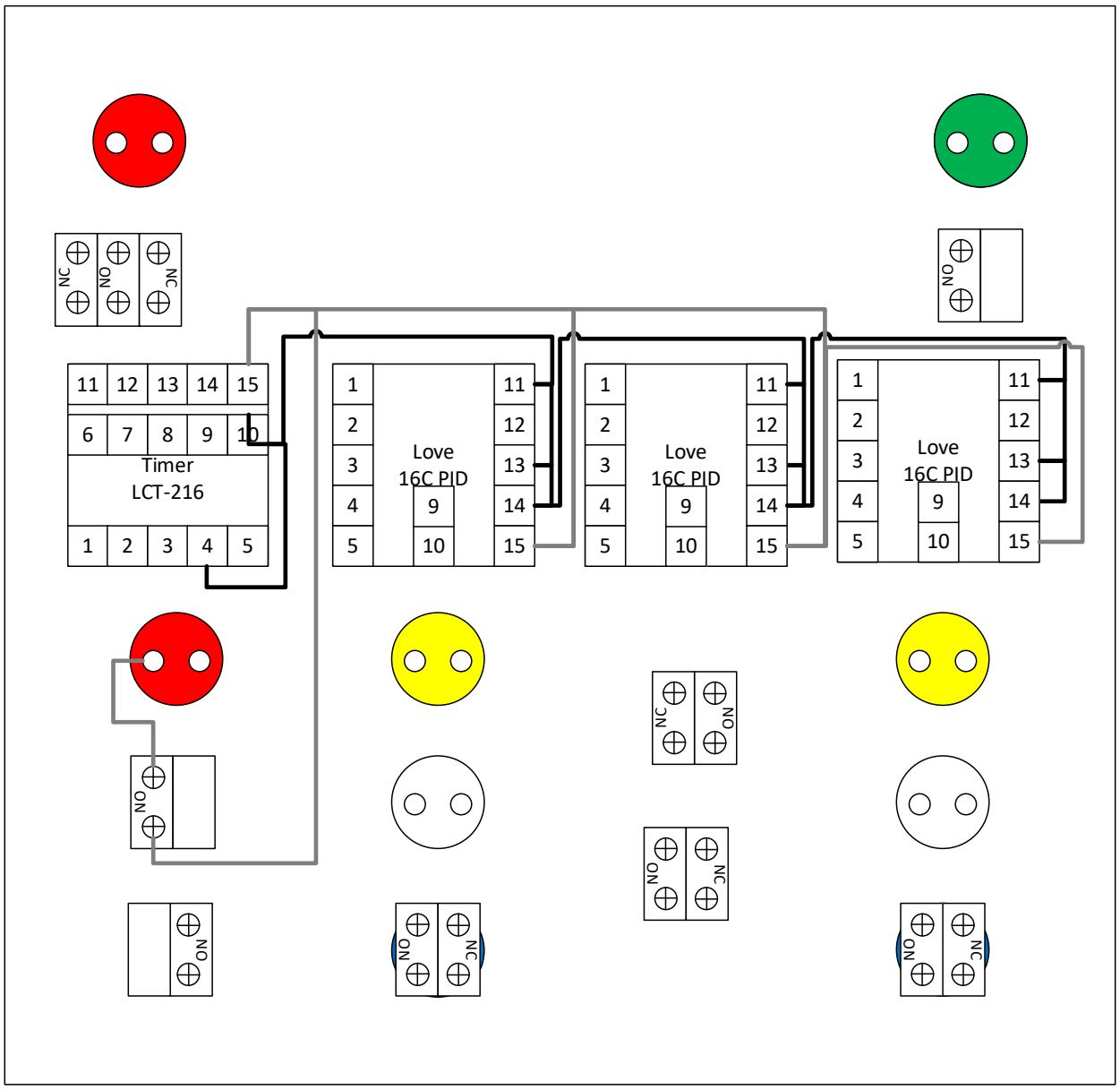
PID Power Shutout Relay Wire up



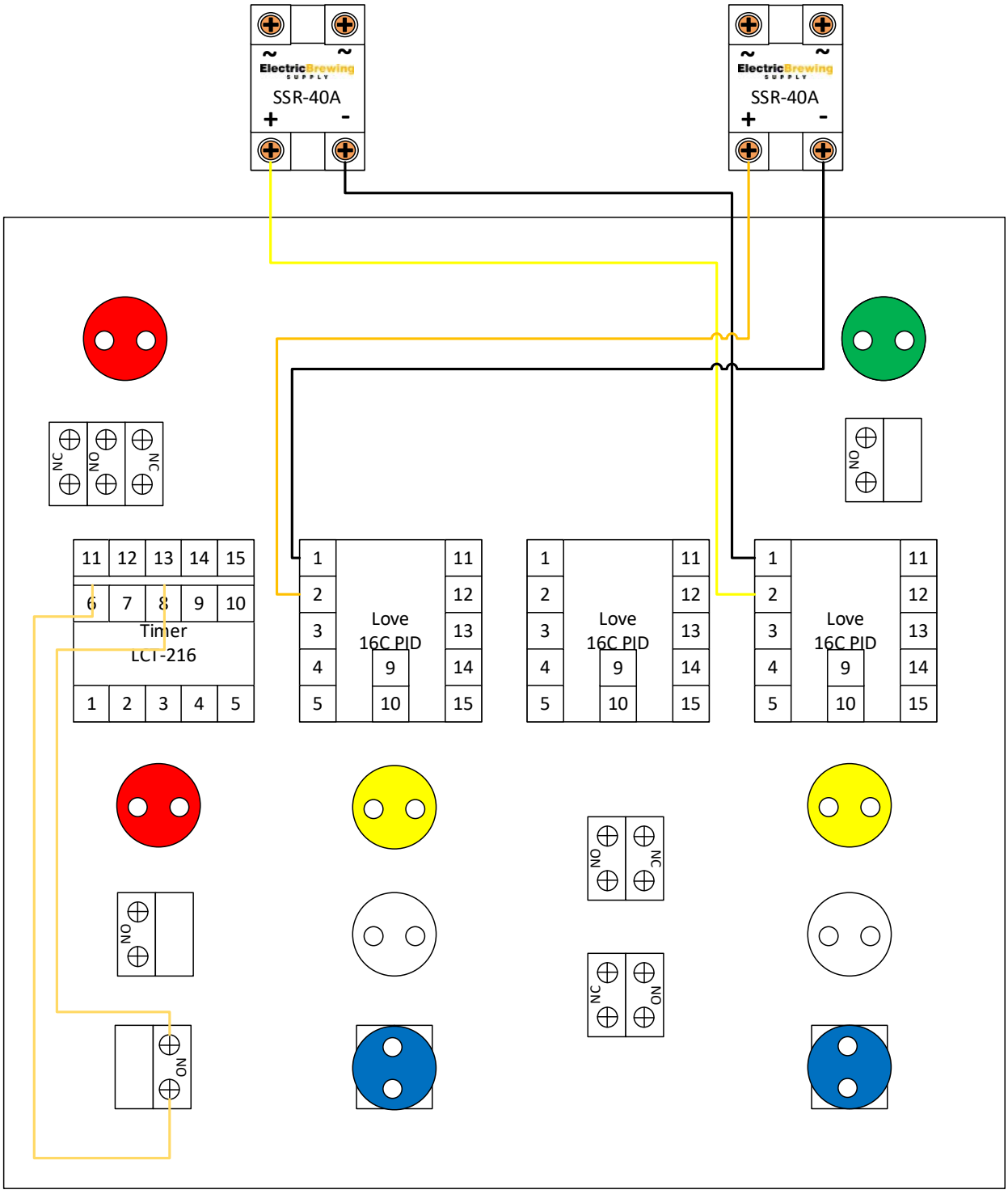
PID Grounding Wires



PID Door 110v Alarm Output Wire up

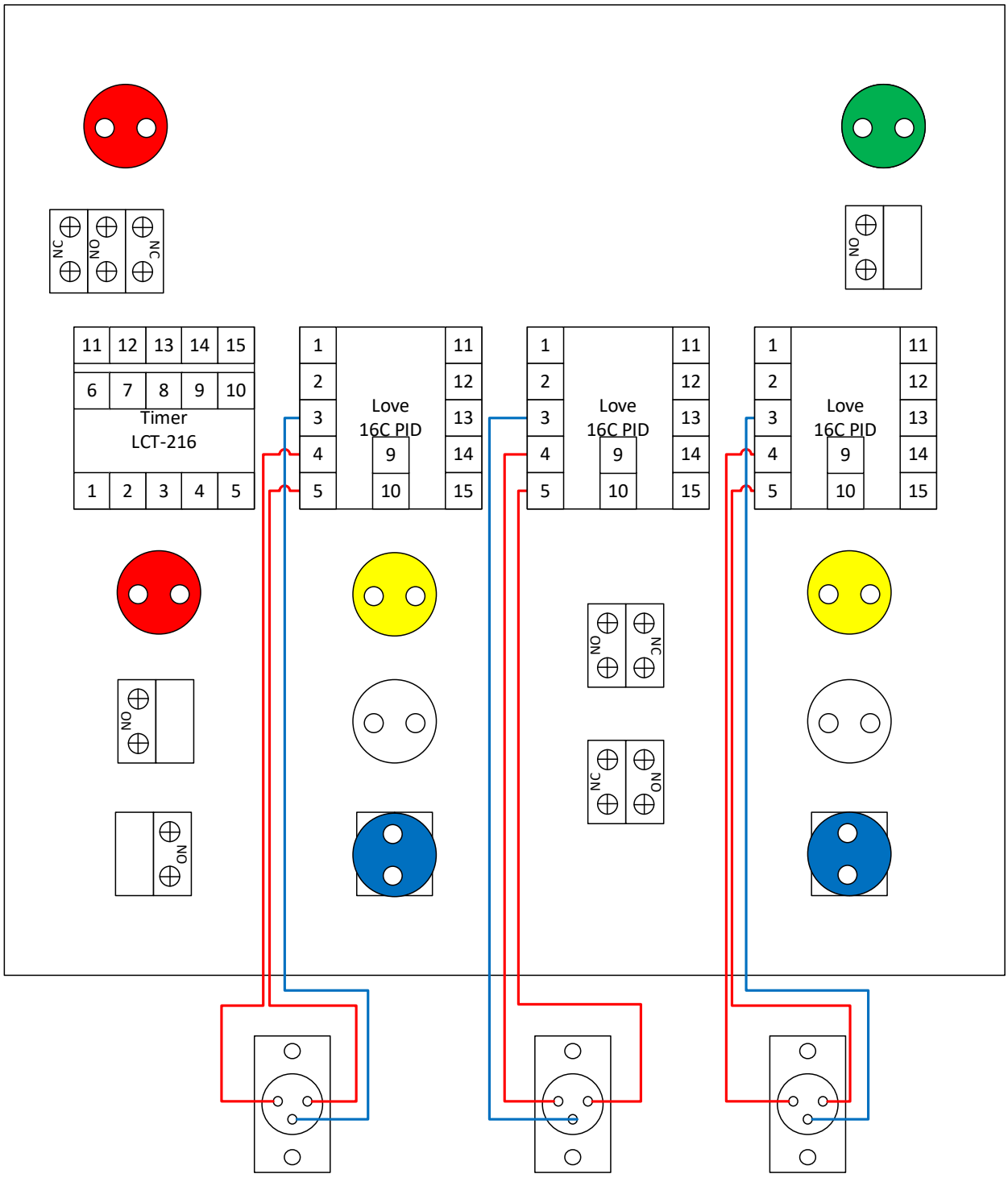


PID Alarm Start and SSR Output



** In our latest update, the Timer functions best with a start button since the reset is on the timer itself. By using start you are able to manual start the timer rather than having it auto run.

PID Temperature Probe Wiring



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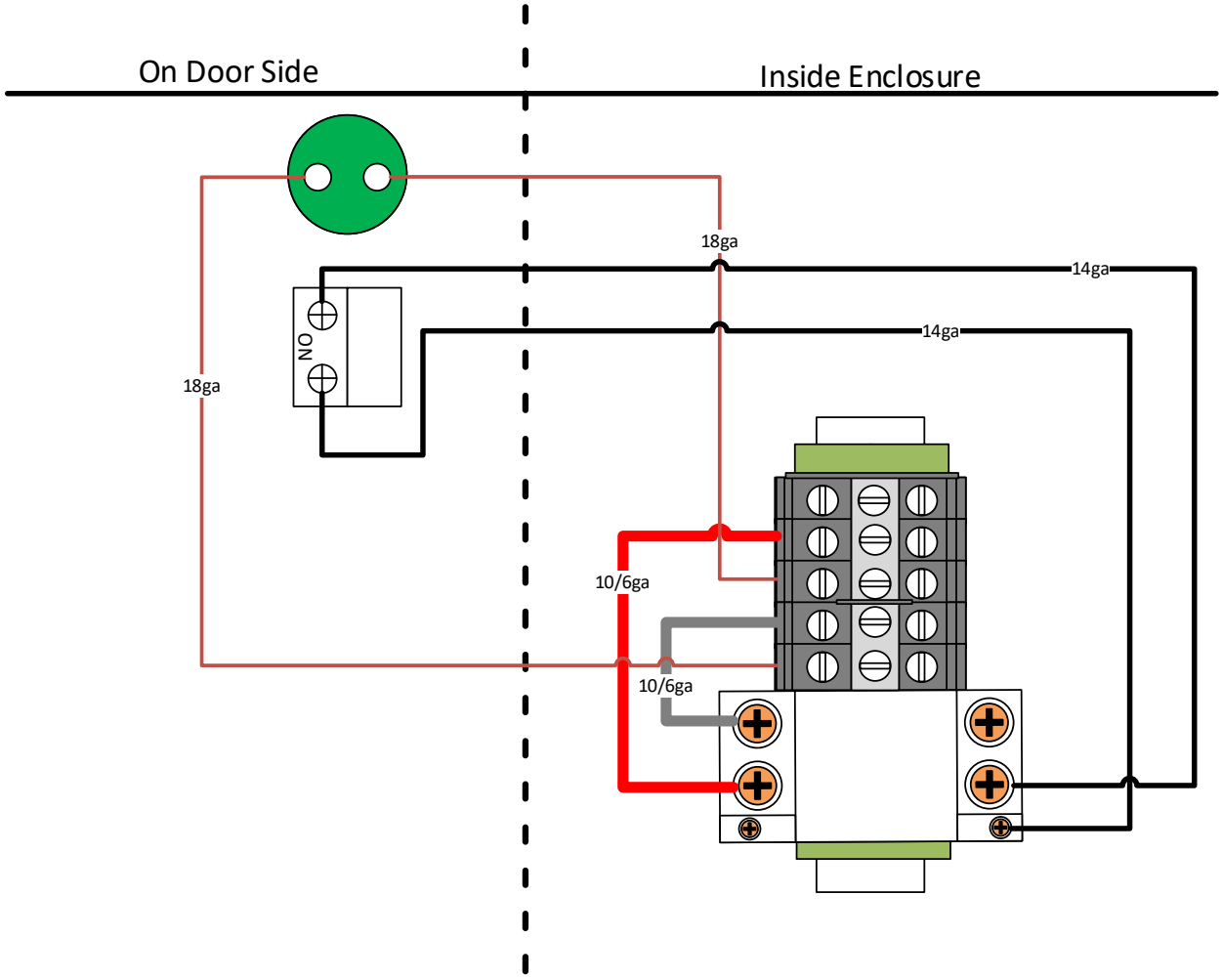
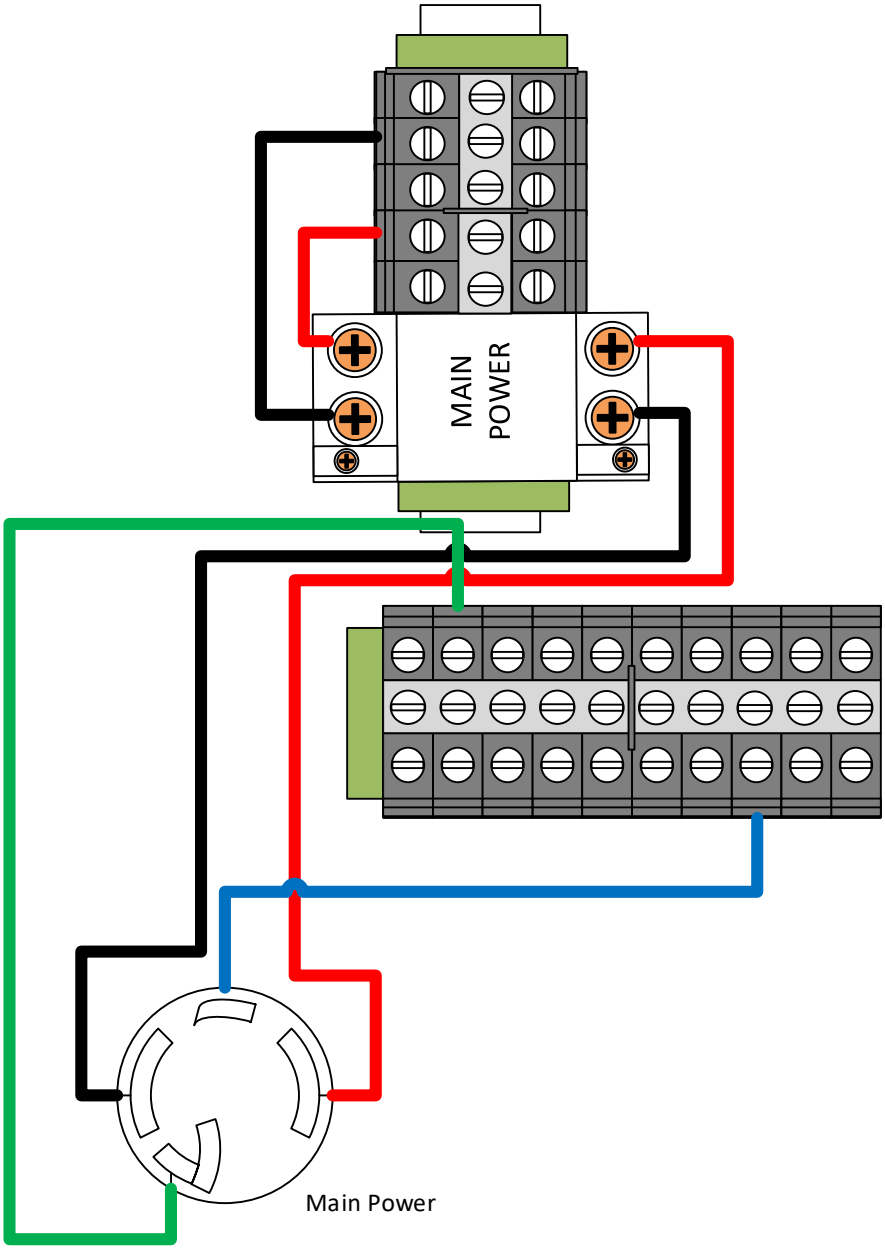
Wiring the Main Power switch and Green LED

This wiring aspect applies to all the layouts for BCS and PID. The key switch is controlling power from the power coming in to the box, and therefore applying it or not to the main coil. Note that if you are building 50 amp panel, the heavy wire will be 6 gauge and the 30 amp panel will be 10 gauge. It is also important to note that the wire does not come in the terminal block closest to the contactor, spacing is important so as to spread the heat out.



Main Power Hook Up

For the wiring pictured, note two facts. Red and black wires will be 6 gauge for 50 amp designs and 10 gauge for 30 amp designs. For the blue line we also use a piece of black wire, either 6 or 10 gauge depending on the design; matching the red and blacks. For the Green line use 10-gauge wire as this will be ample.



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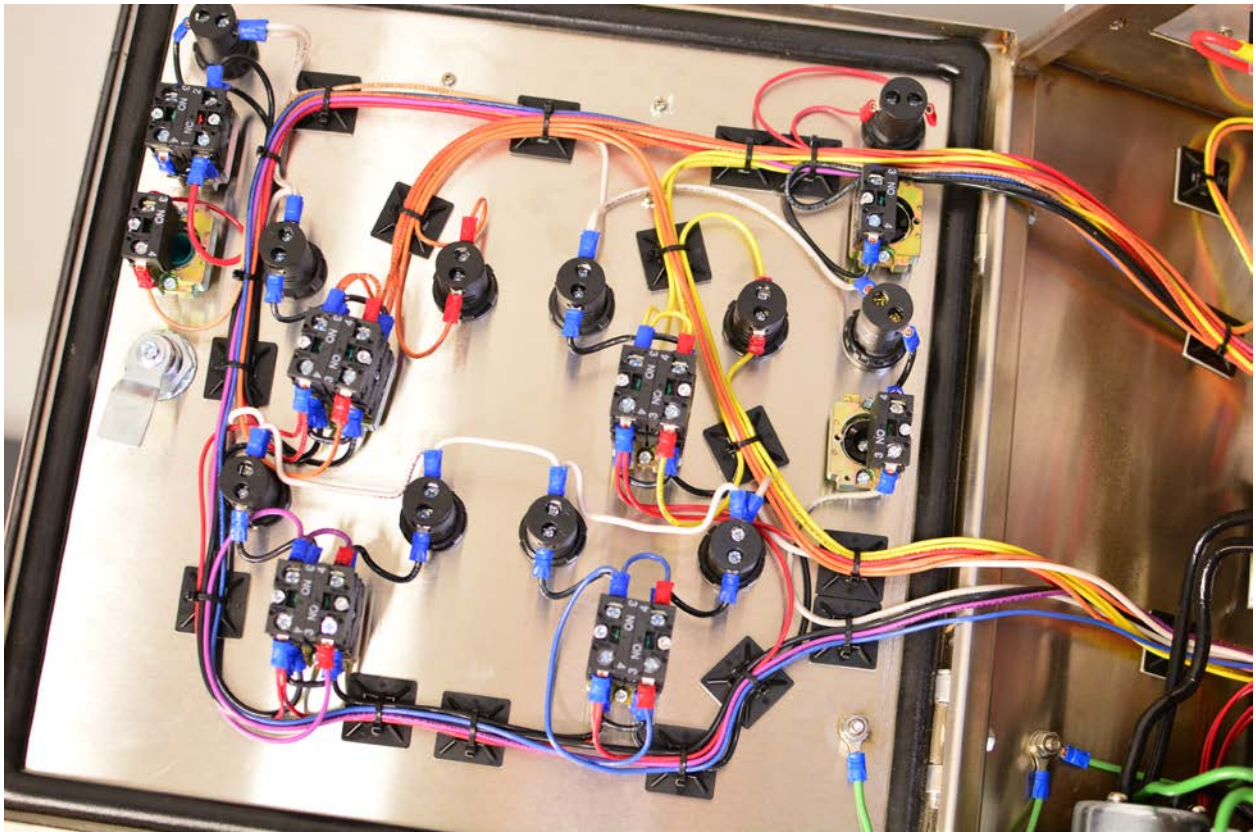
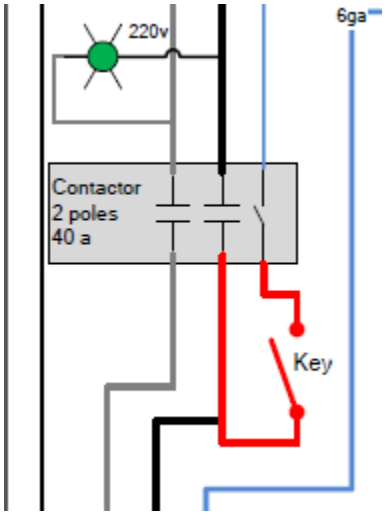
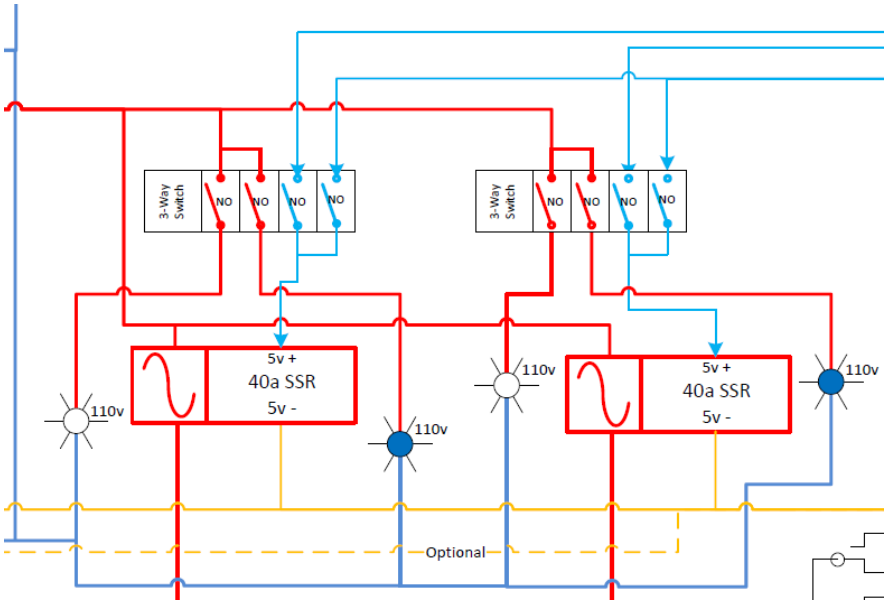
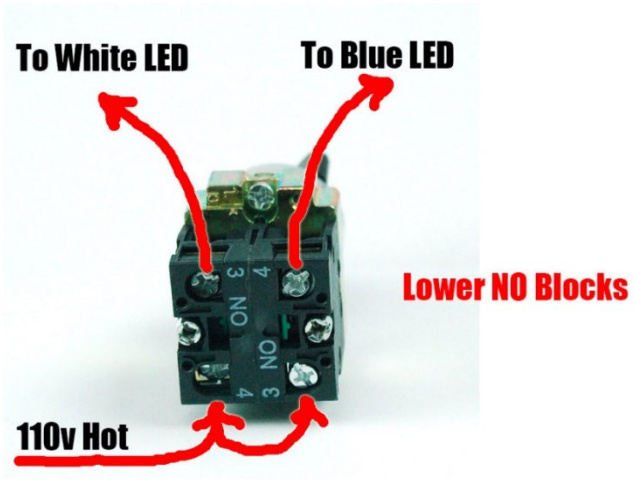
Wiring your Switches in

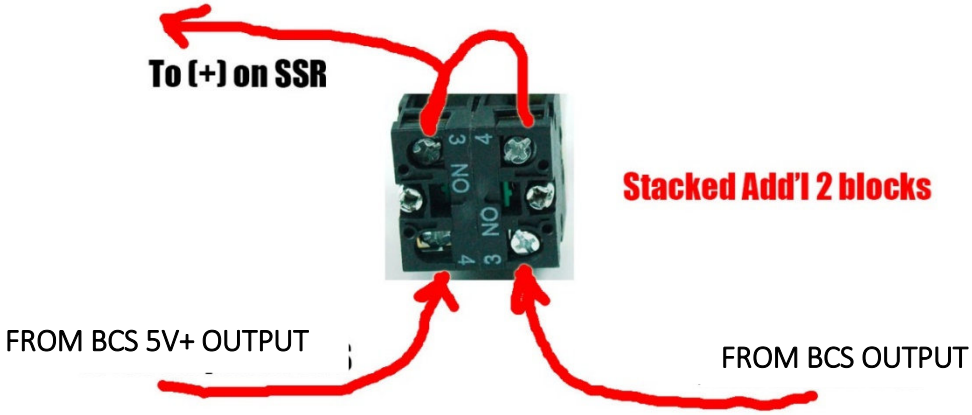


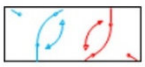
The key switch:



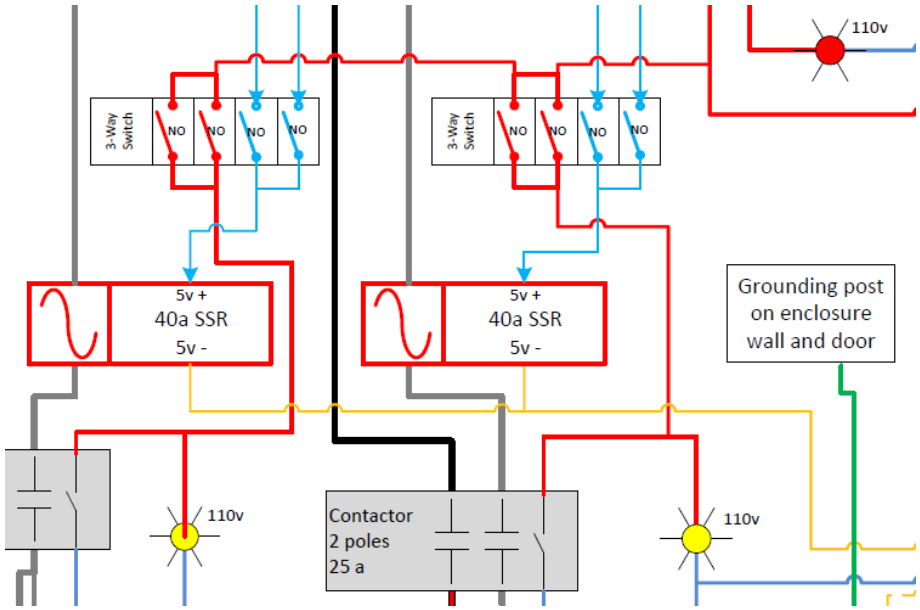


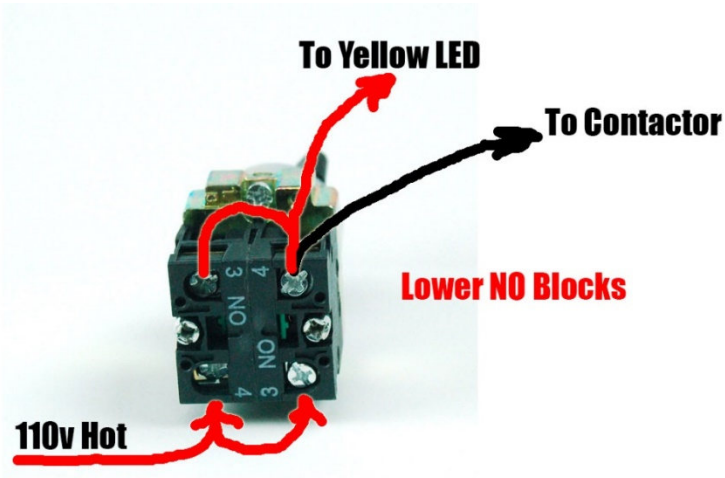


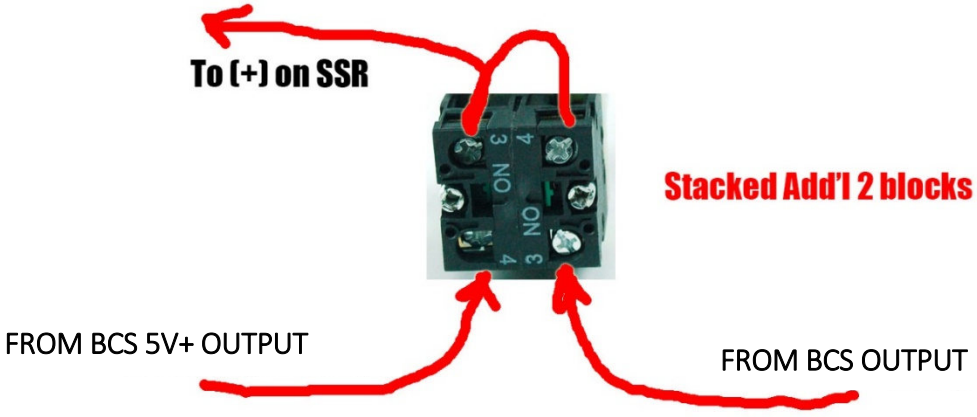


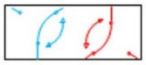


Wireing Up your Pumps



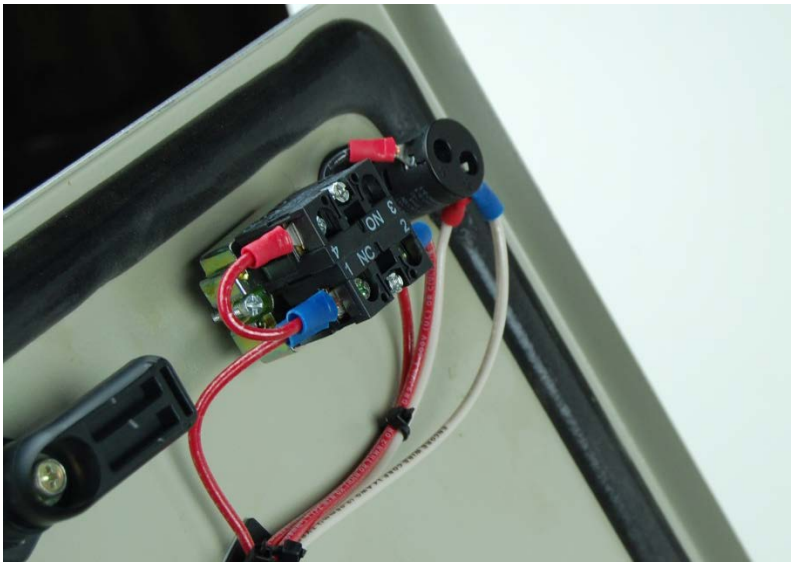


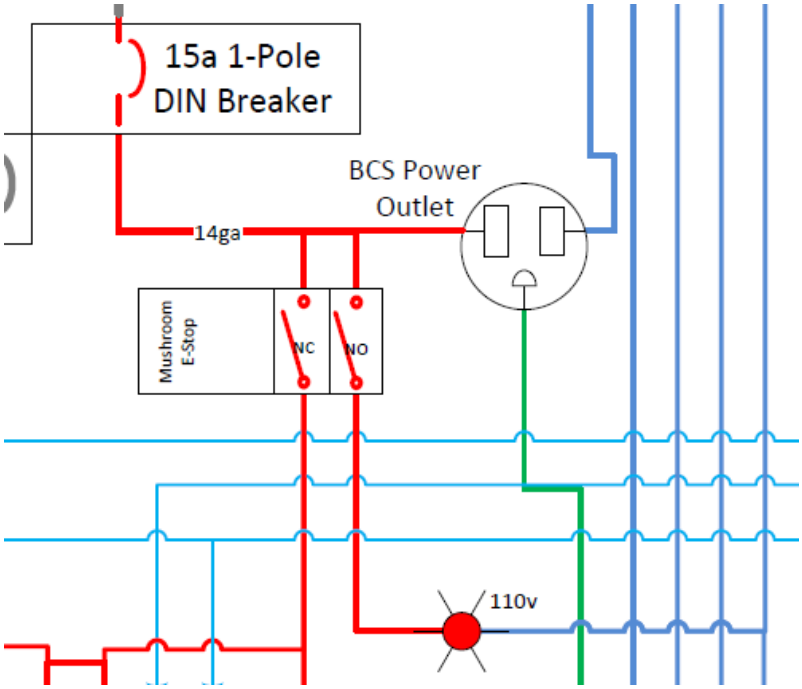




Wireing Up your Element

Wiring in your e-Stop

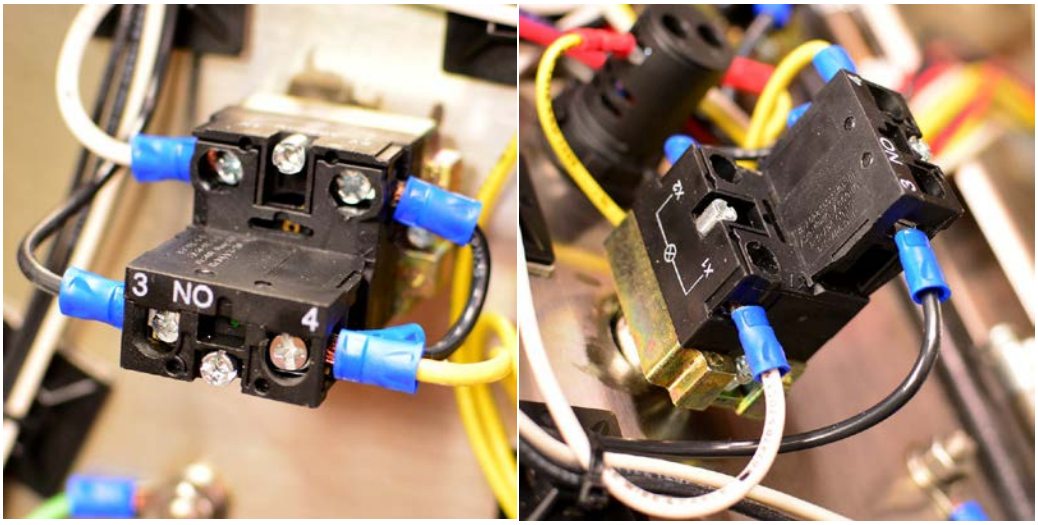




From the main breaker the power runs into the e-stop. At the e-stop a jumper is attached connecting the NC and NO contacts on the same side as the power from the breaker. On the other side a short jumper connects the 110v Red LED to the NO contact and then from the LED to the cluster of Common (white) DIN terminal blocks. On the NC Contact side the power is then distributed to the switches, as well as to the pumps.

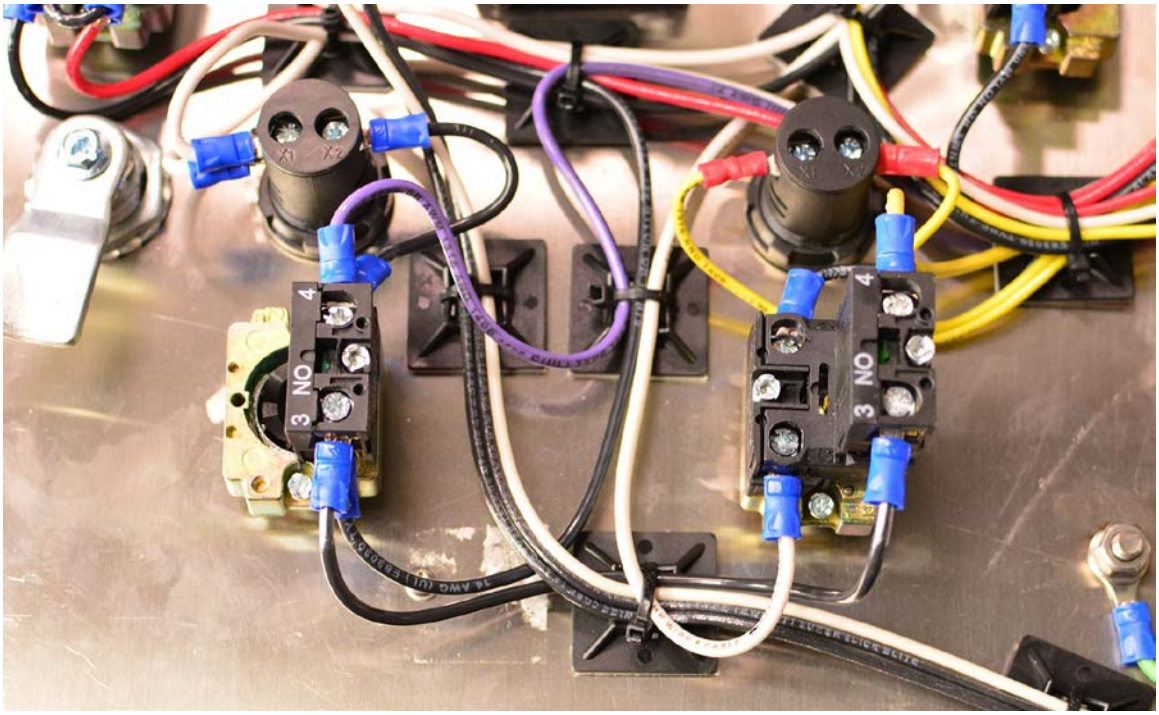
Wiring of LED Switches

Frequently we receive emails asking why one's LED switch isn't lighting up. We prefer these switches in the PID design as they keep the hole count down. It is important to note that all switches and leds are just that, a switch and an LED. What this means is that in order for the LED to function as one, you must wire it according to the function you want. In the PID designs that means there is short wire going from the NO Contact block to the screw beneath the NC block. We recommend removing the NC block from the switch back to make this connection as it will make it easier to get at the screw. You will also need to wire the other LED screw to your common circuit.

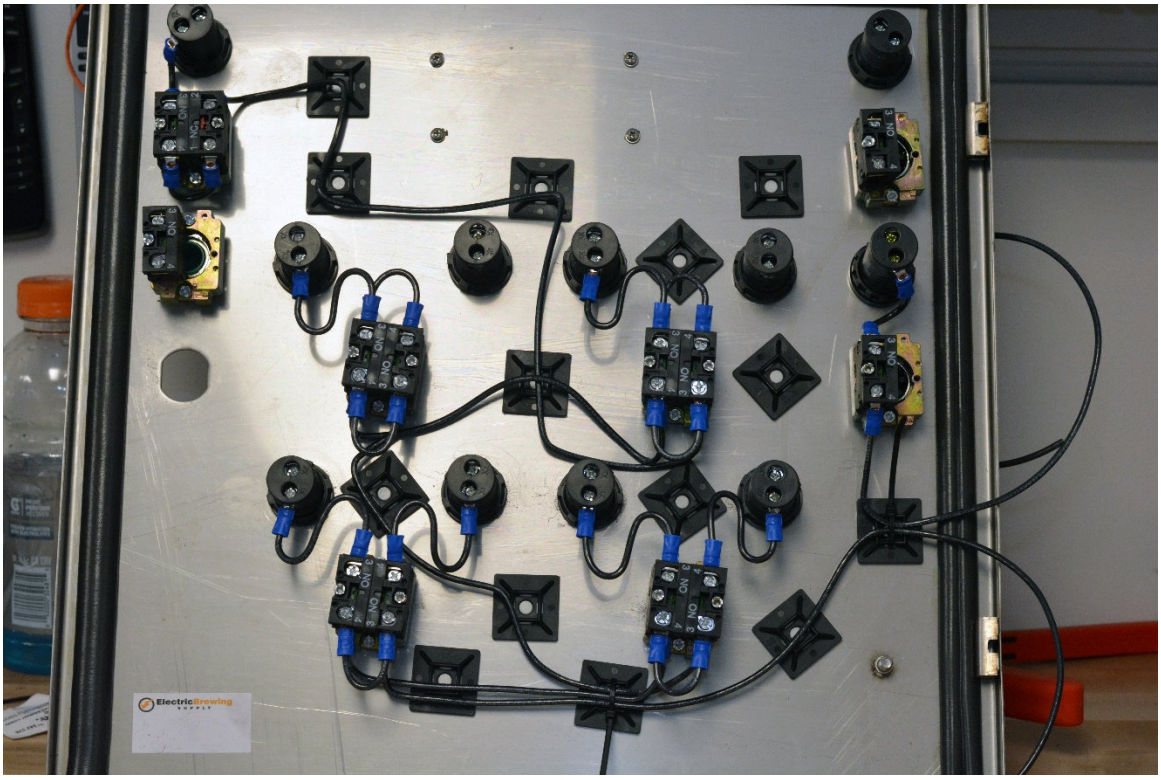


The above is an LED switch wired. The NC block has been removed to show the screws.

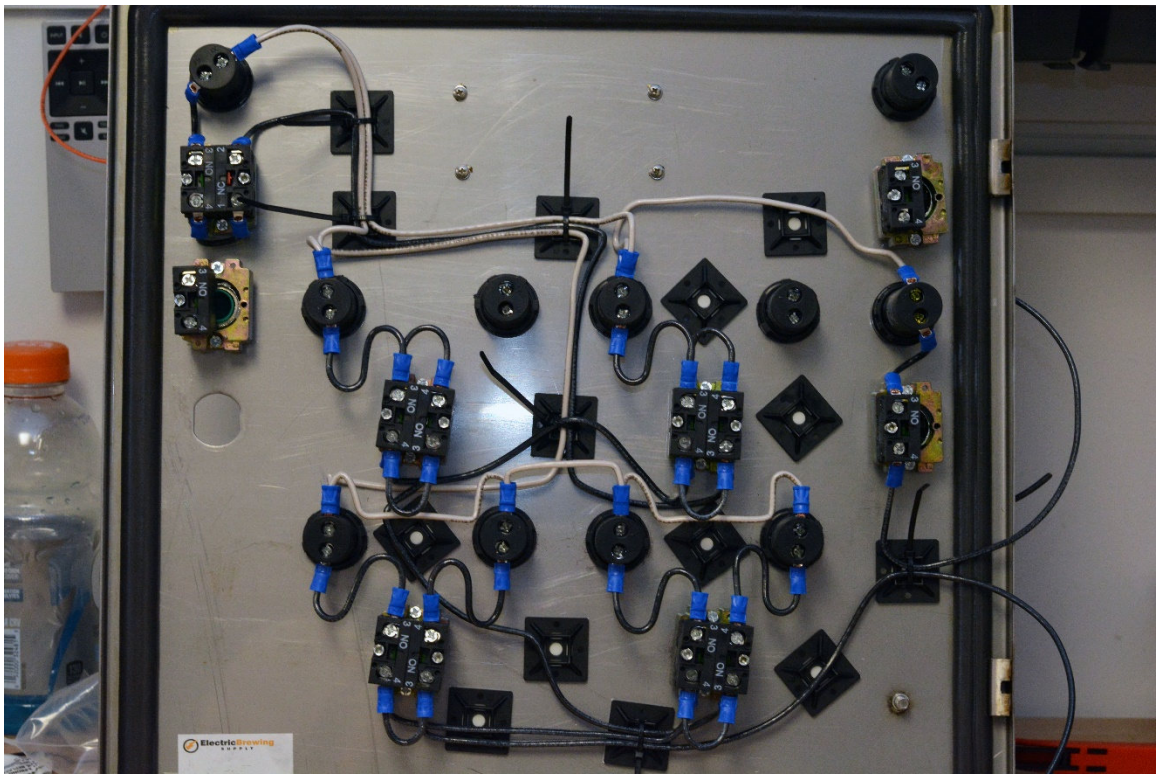
A comparison of the separate LED wire up with switch on the left versus the LED toggle switch with LED on the right. This picture is from the inside of a BIAB door, the right is the element contactor toggle switch and the left is the pump switch.



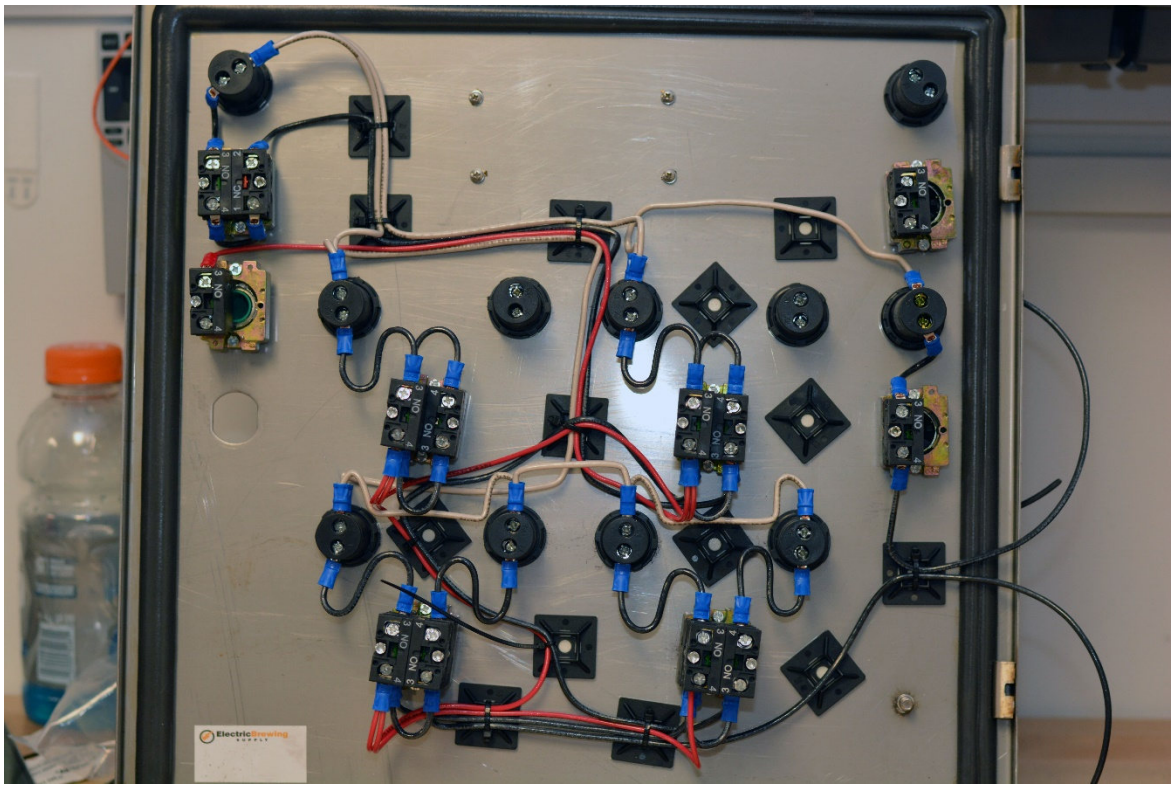
Backside of 50a door – 110v Wiring



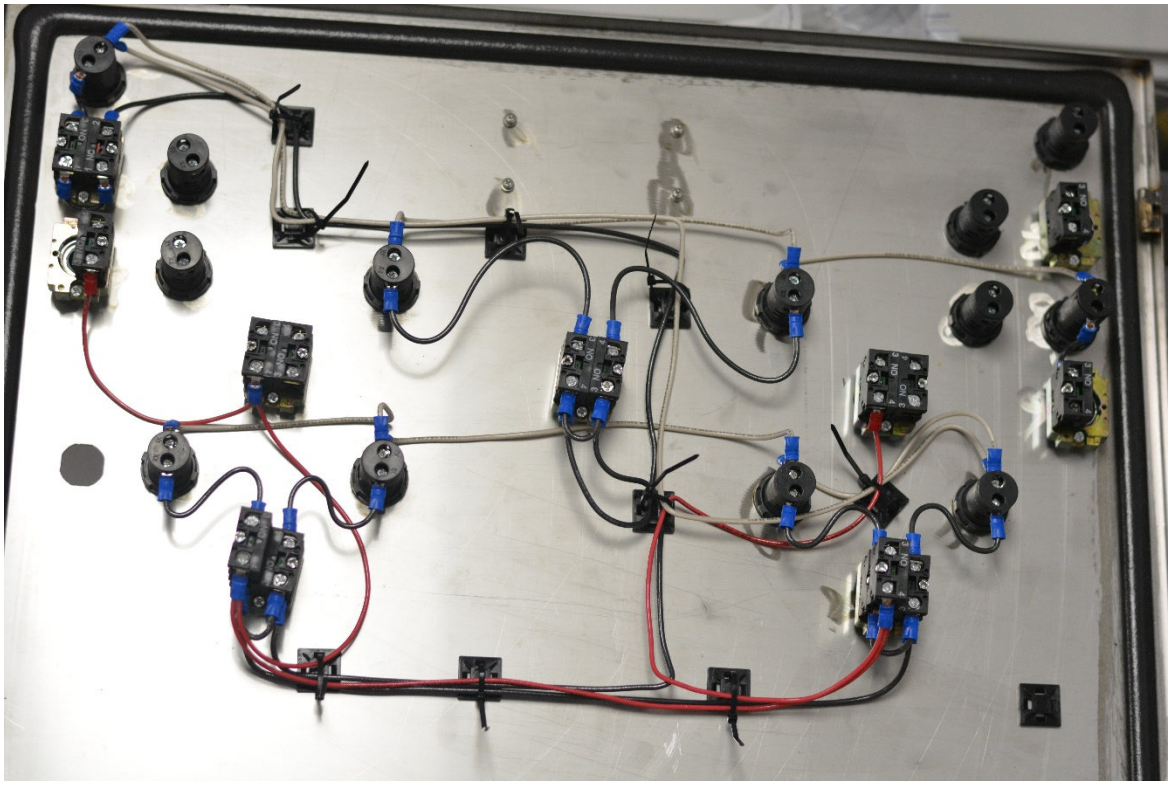
110v Hot side wired up to switches and leds.



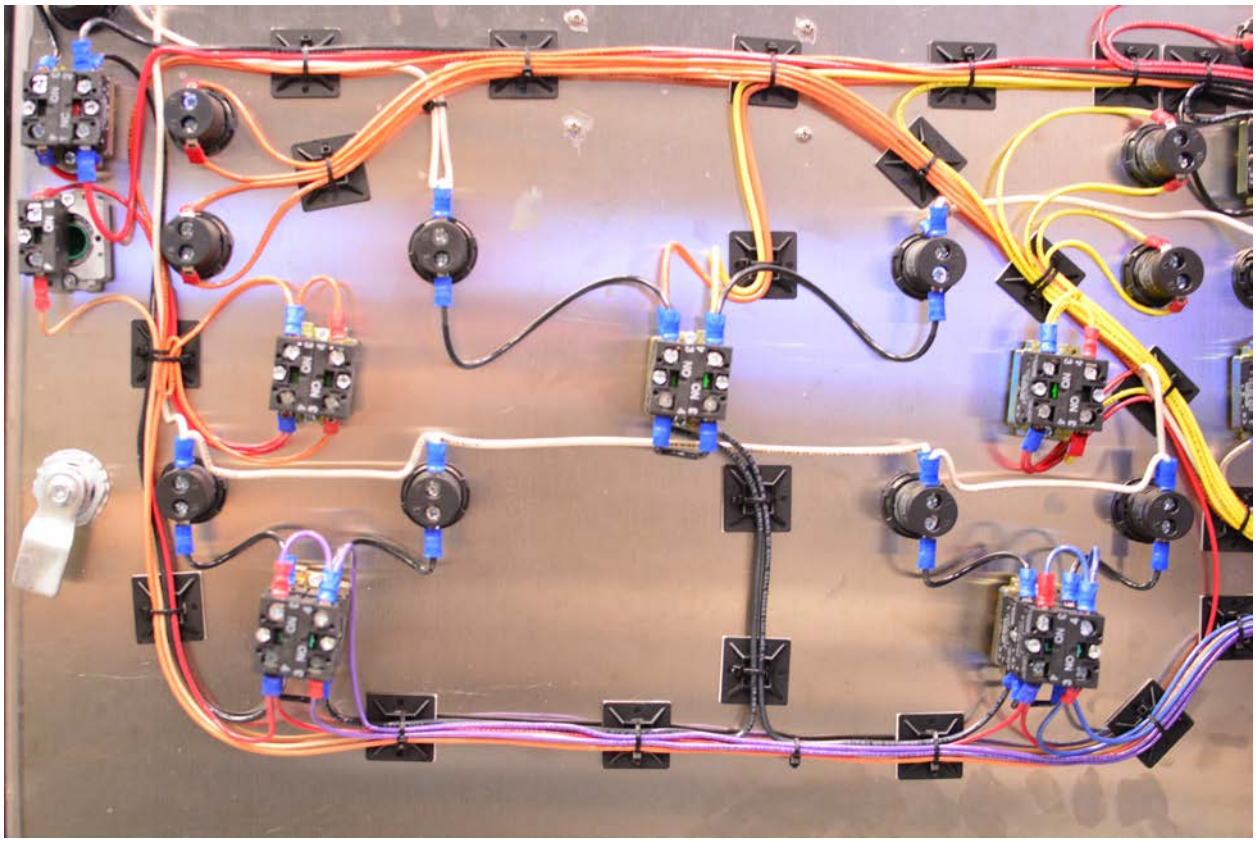
110v Common side wired up



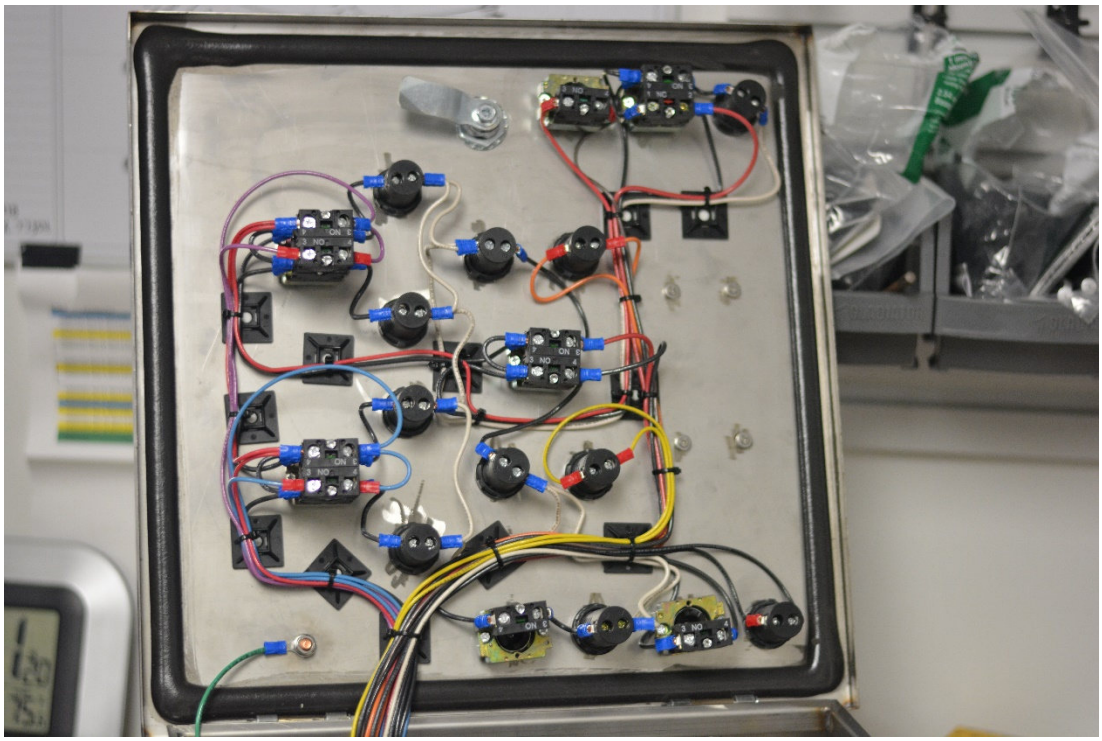
5v+ hot wired to door, now the door is ready for the next phase of merging the box with the board and door. Note that on the element switches, only the 5v NO blocks are currently in place.



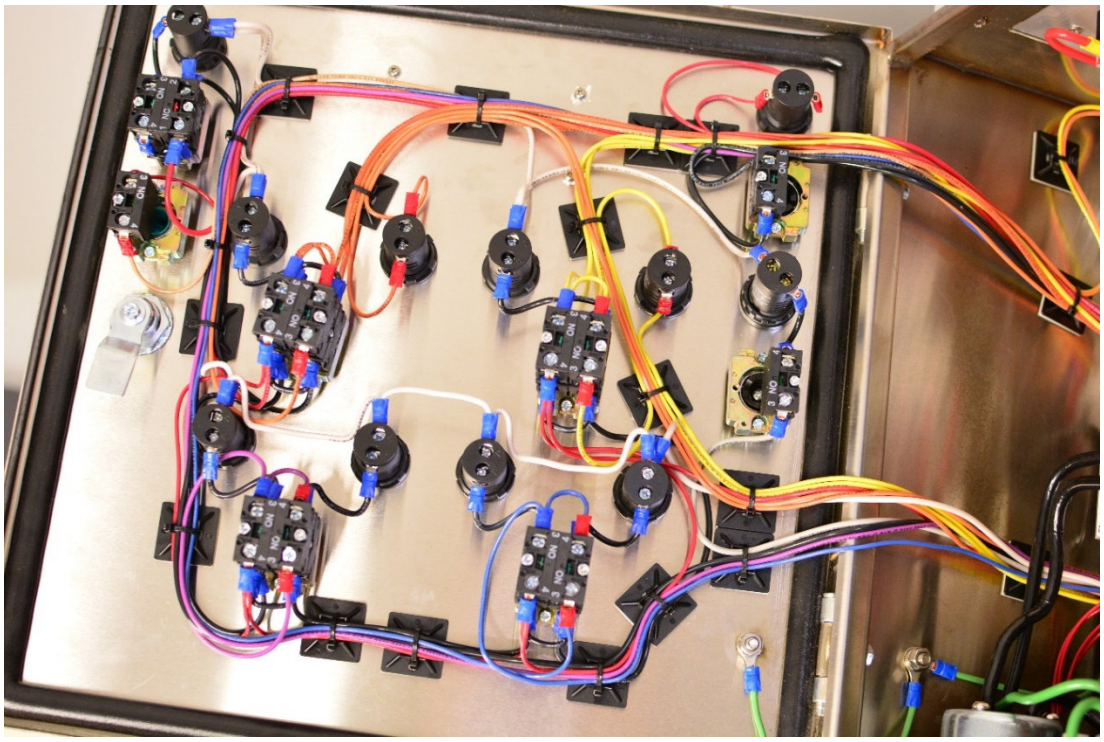
The back side of a 50a 4 element door wired up with the 110v hot and common sides.



The back of the 50a, 4 element panel shows a combination of the 30a and the 50a 2 element panel doors. Here the panel is completed, with all wiring from the board inside the enclosure, etc.



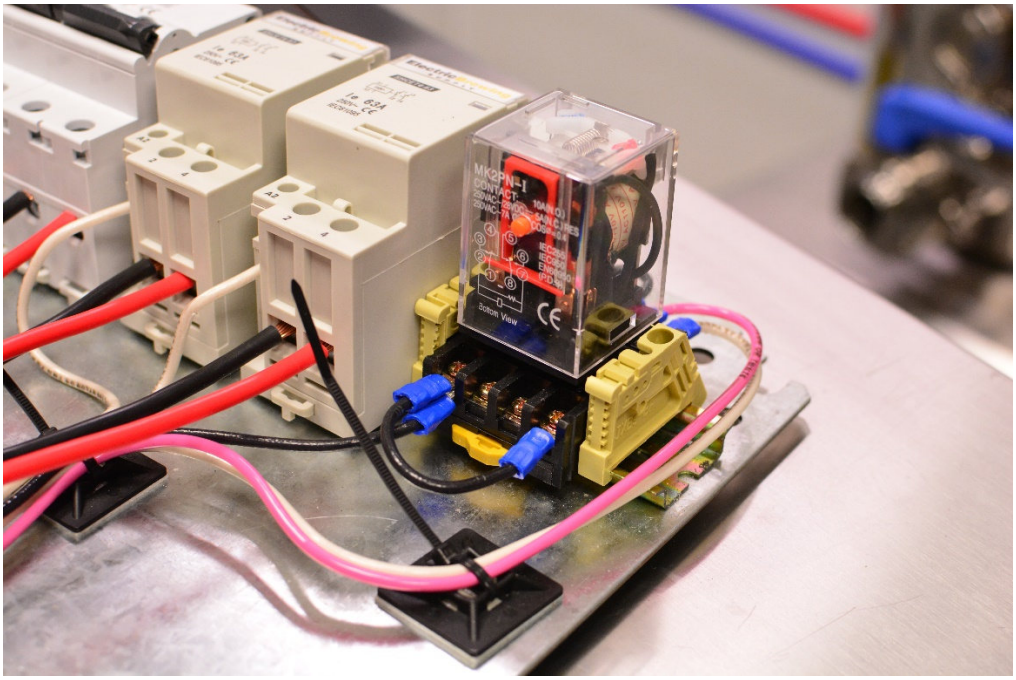
A 30a door is completely wired up and attached to the enclosure.

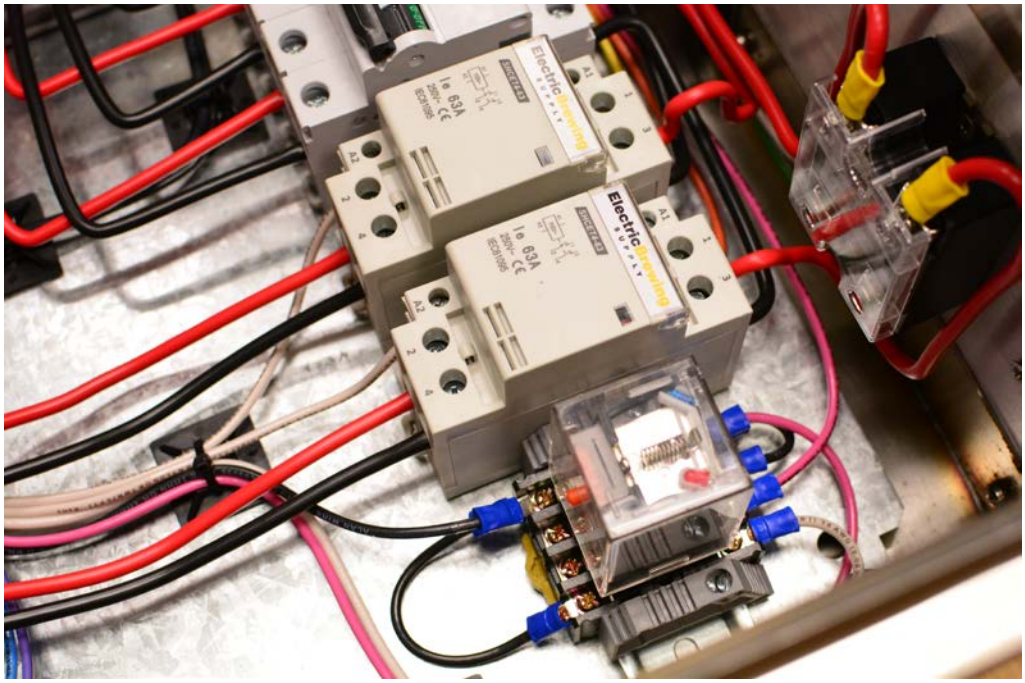


The completed 50a door using our circular wire mounting approach as drawn in the CAD drawings.

PID Shut out circuit

For the PID panels, due to the active nature of the PIDs, we use a relay to control the power to the pumps and elements. This relay is in place to prevent the panel from in advertently powering your pumps or elements at power up. The relay wiring can be a little confusing to understand but to best explain it we'll lead with a few pictures and then try and break down what is occurring.



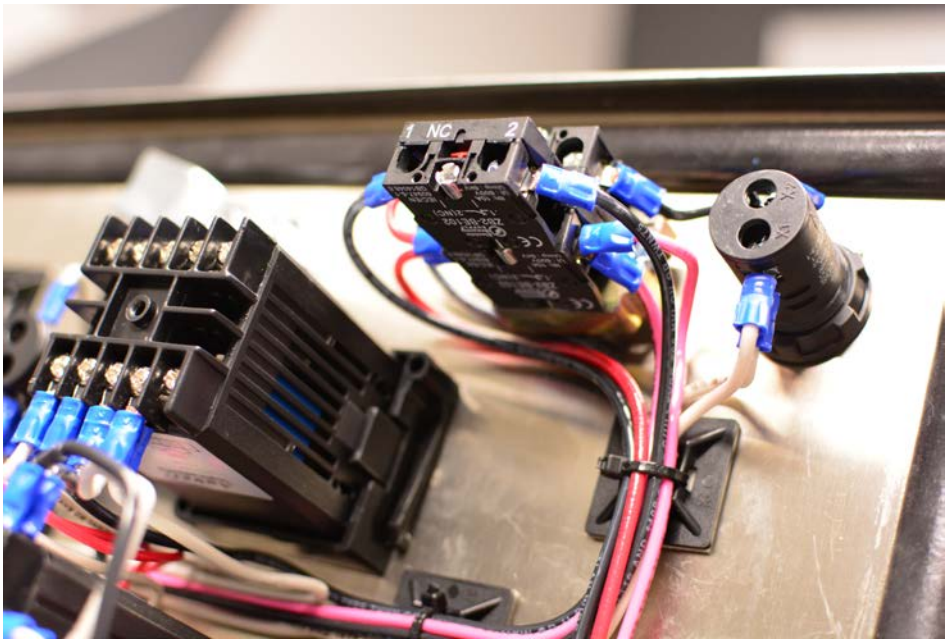


To help identify the circuits inside the control panel, we use a bright pink wire identifying the shutoff circuit. This is important as it will help you in your wiring.

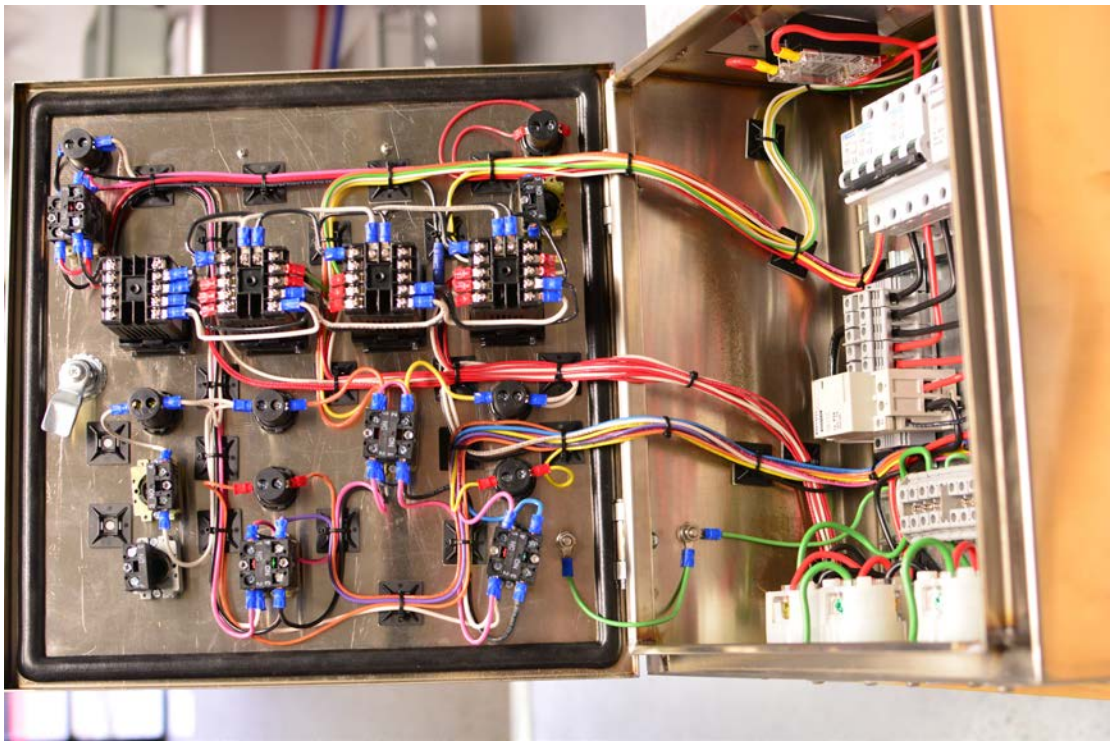
When installing the block, be sure the din rail tab is pointed to the bottom as we have. Along the top you will have all 4 pins wired while the lower will only have the 2 jumped. The top is most important because if it is incorrect your whole panel will not cooperate. Pins 1 and 2 need to be jumped, from here (contrary to the picture) the long run should wrap around and lead to the lower side of the sub-panel board. This will be the equivalent of the end of the circuit. Pin 3 with its pink wire, will run to the e-stop and receive power from the e-stop at power up. This is the wire that powers up the relay. From the e-stop, on the same screw, a second pink wire is then run to the first NC block on the element or pump switches and proceeds to daisy chain from one NC block to the next. At the end of the NC block chain, the pink wire from pin 1 will meet, completing the fail safe loop.

From the bottom, the far left and far right pins are jumped, this wire is then run all the way to the e-stop. This is the wire that will provide power to the elements and pumps if powered. We typically indicate this wire with black wire. Run this into the second NC block, from which another black wire then runs the NO blocks of the element and pump switches providing power.

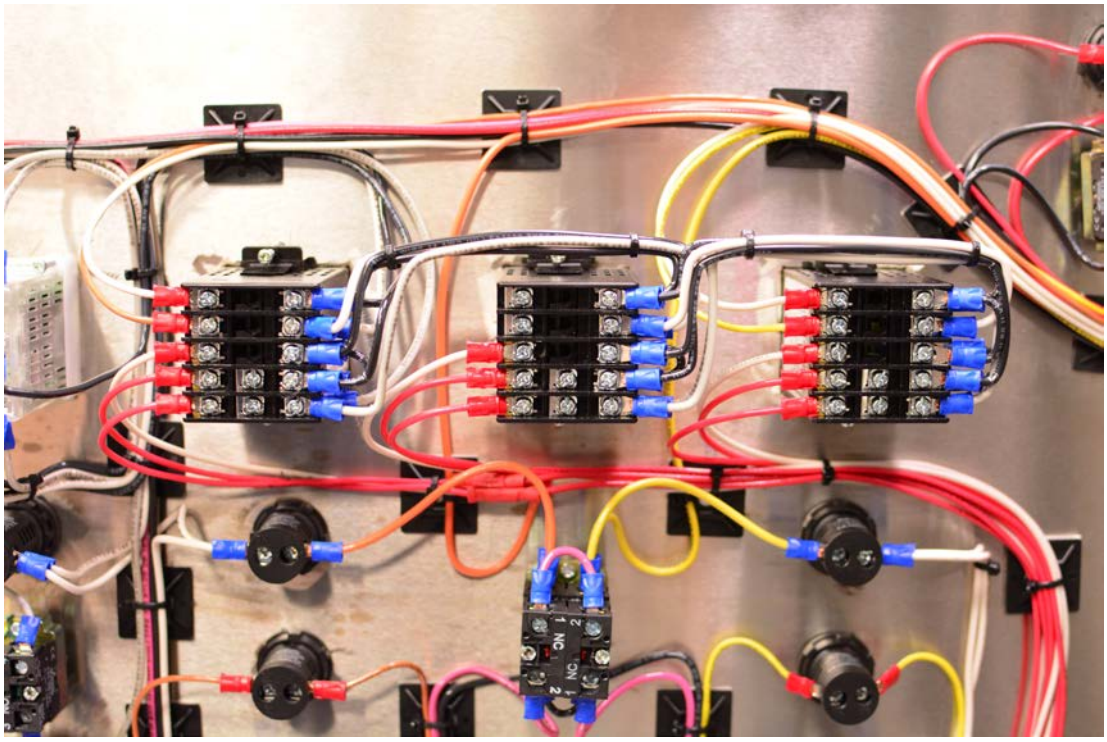
If everything checks, when you power up, if any of the pump or element switches are in ON, then neither the pumps nor the elements will power. Once all are toggled to off, then the relay will trigger and everything can then be used.



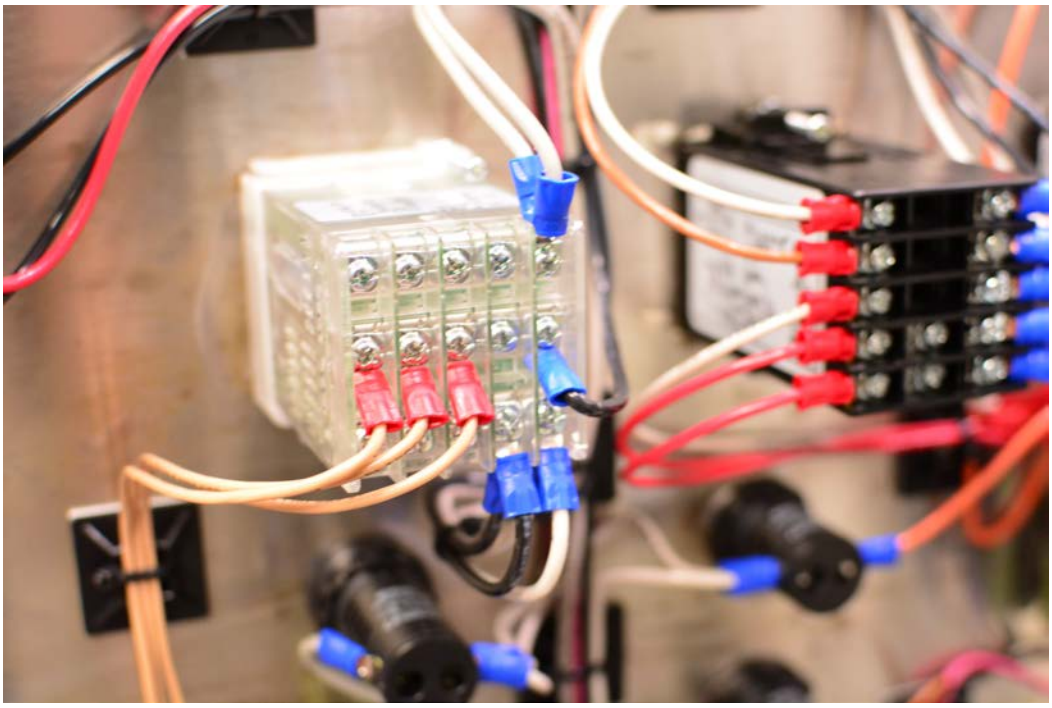
The e-stop wired up on the PID Panel



A completed 30a Auber PID door with the pink wire running for the protection shut out circuit.



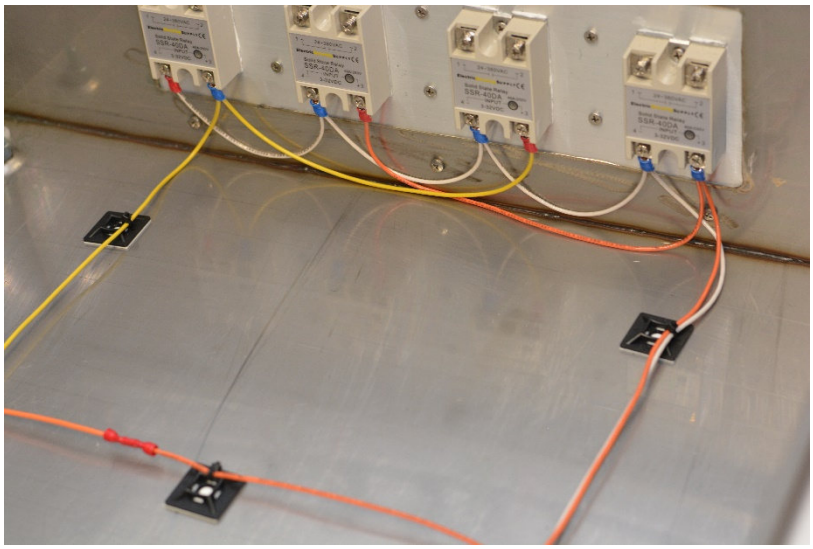
All new Love PIDs wired in with alarm output via gray wire.



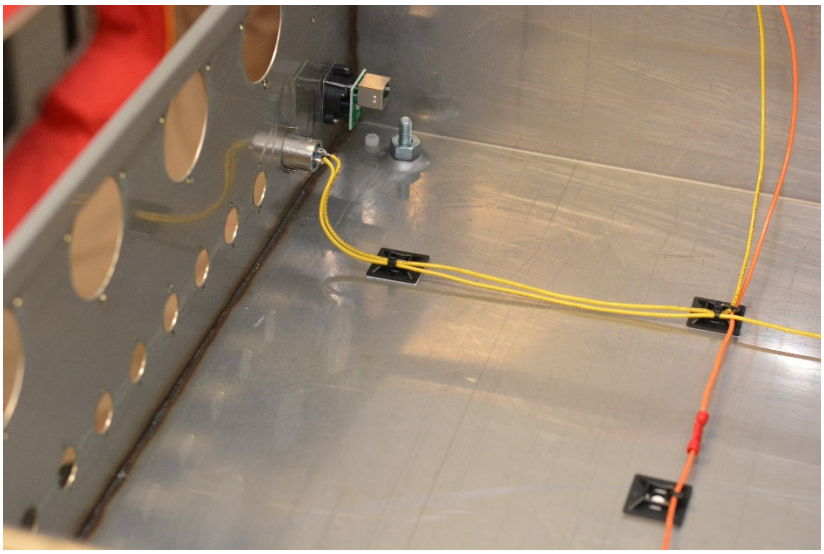
Love LCT216 Timer wired in with Start and Reset both being used in push button form. Because the timer has a reset button on the bezel, we recommend using the push button for start functionality in our latest designs.

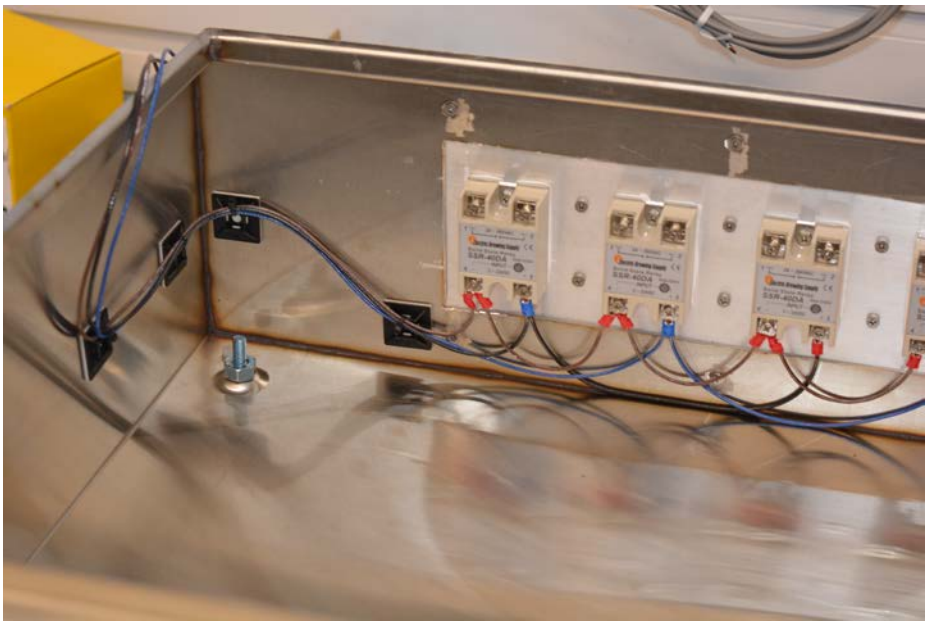
Bring it all together

Now that the interior board and doors are both done, it is time to combine the 2 pieces along with the enclosure into one complete package. The trick next is to start by attaching the heat sink with the enclosure. Once the heat sink is attached, be sure to wire up the 18ga GND wire to the SSRs (-) negative side. Next, in the case of the 50a, you need to add an additional run of 18ga wire from the (+) side of the SSRs to the door.

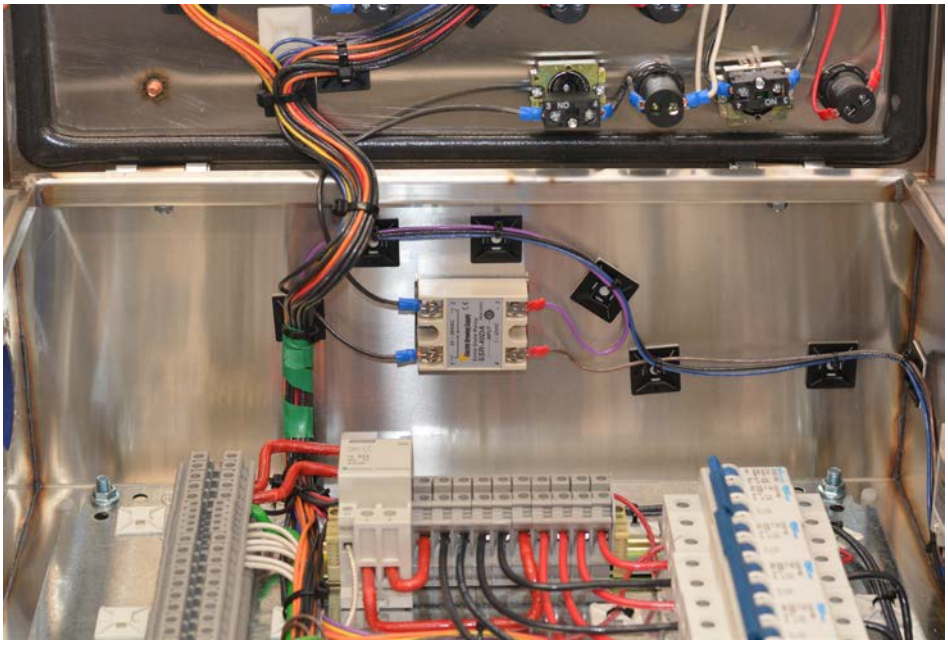


There are 2 ways you can route the wire. The above and below shows routing with a float switch at the bottom of the enclosure. Where we use an XLR connector with a long run of 18ga wire looped across the 2 outer pins. The loop runs about 8 ft and by looping it we can insure the reach to the SSR, and then have the other end of wire go to the door for user control.

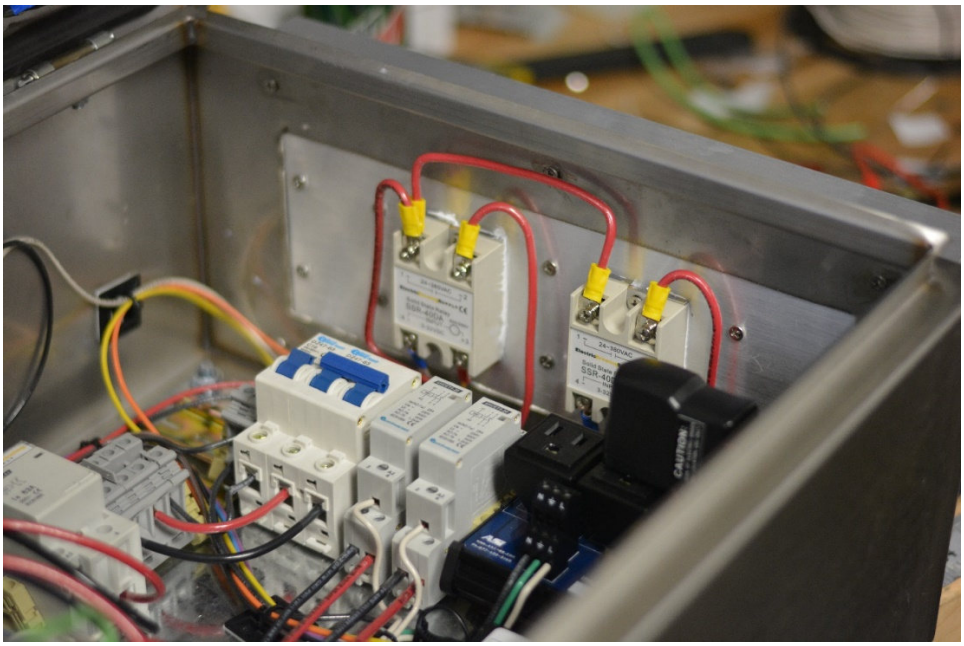




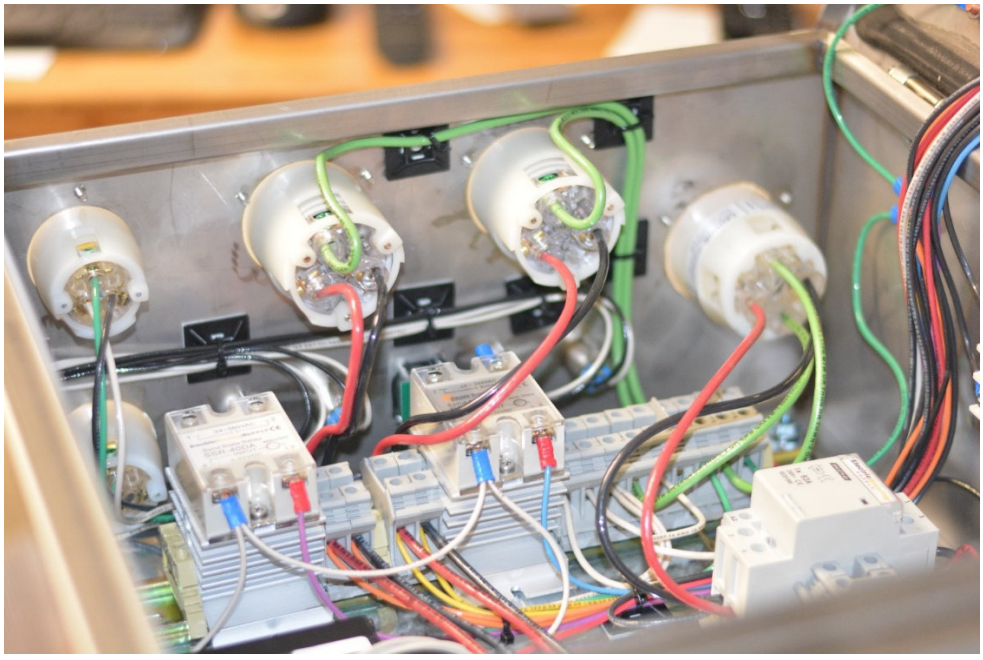
Here is a 4 element panel wired without the float switches.



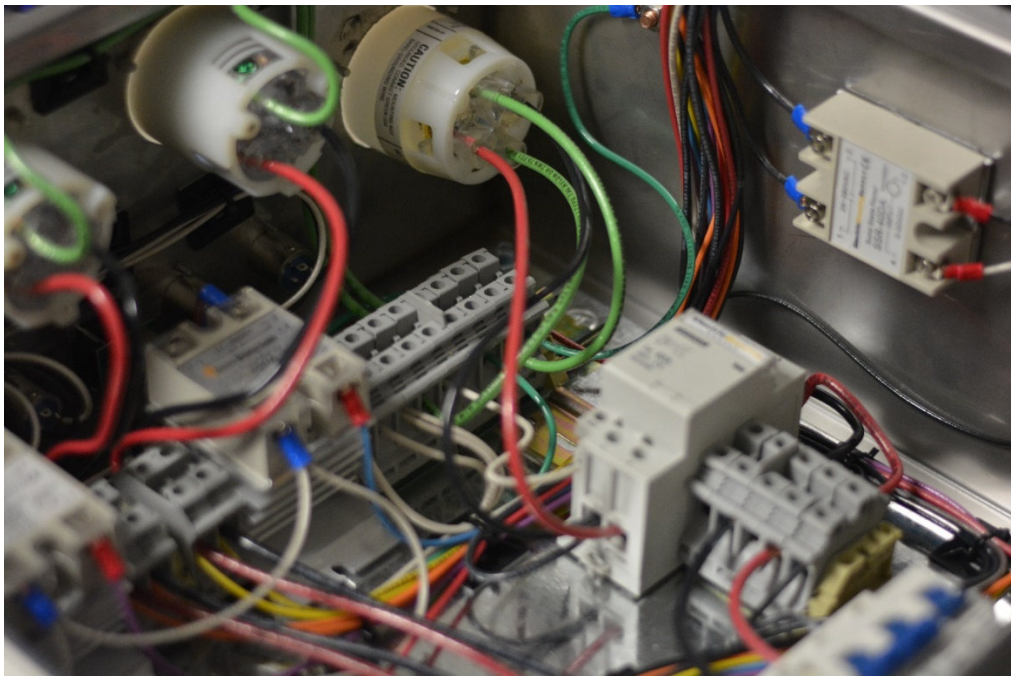
Here is the alarm SSR mounted on the inside of the enclosure. For easy mounting with no marks, 3M exterior super strength double sticky tape is used. Since this is the alarm relay, amperage draw is less than 1, so there is no noticeable heat generated for the few seconds the alarm may be used. **This method is no longer used with the transition to SPDT relay boards with 3 and 4 relays.**



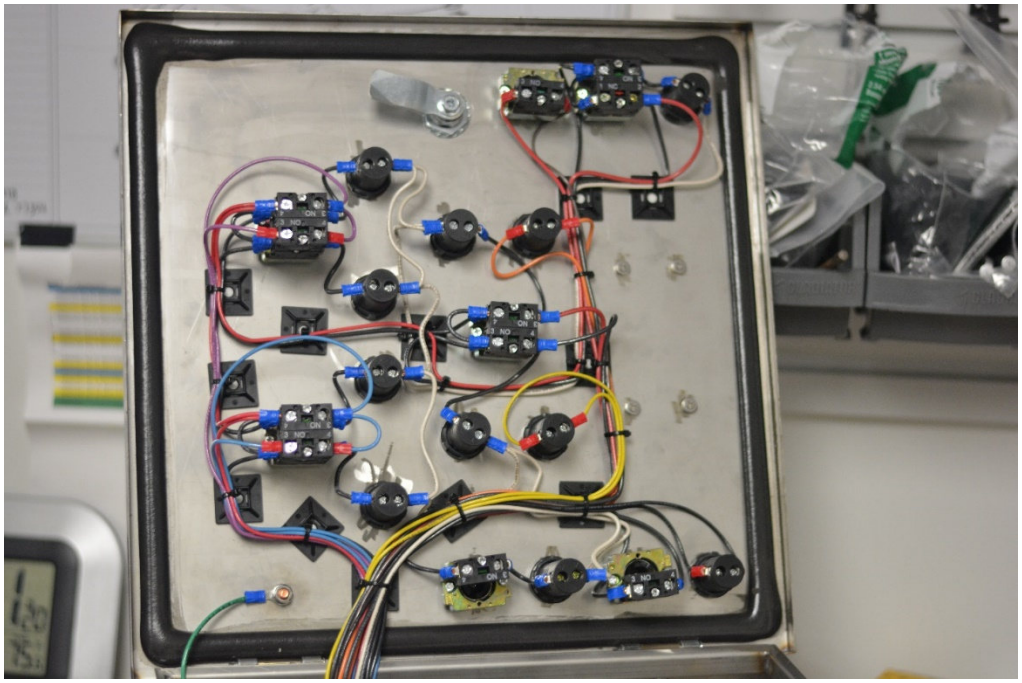
Here is a 30a enclosure wired up where instead of using terminal blocks, we've made sure minimal loose wire is coming out of the crimp and with that we are daisy chaining in parallel the second element since only 1 may be used at a time. Because of heat, it's best to be sure you don't have loose or random wires exposed as they can cause scorch marks.



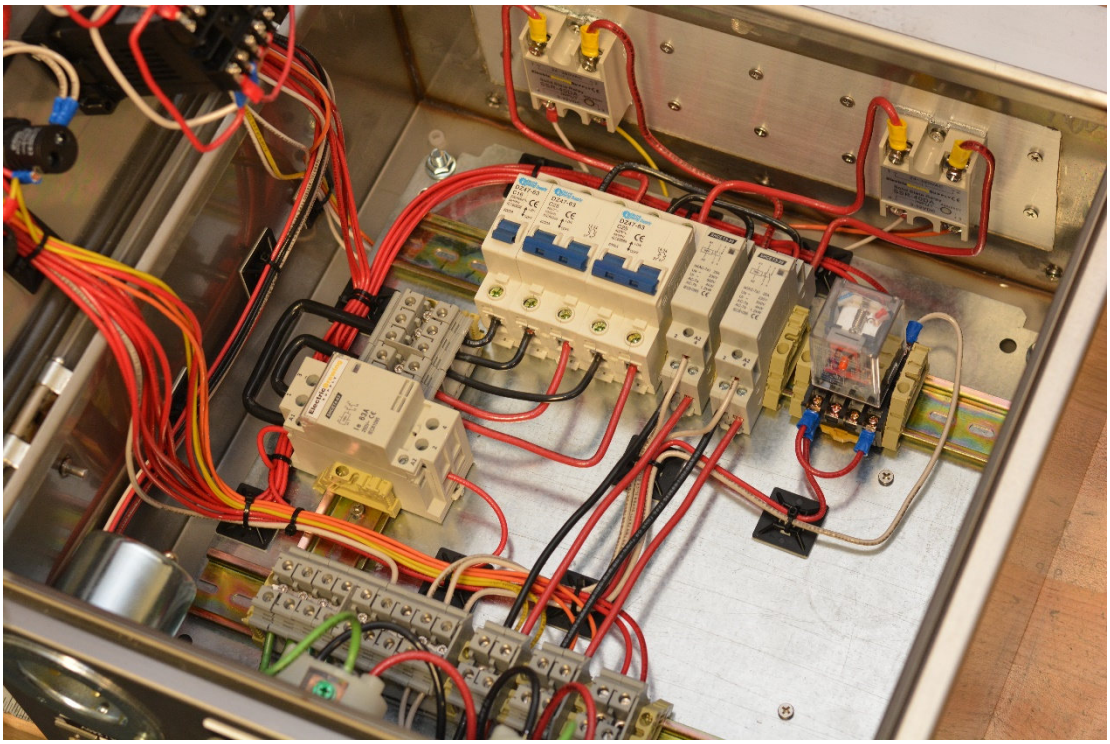
The bottom side of the panel is drilled and tapped, so no nuts are needed. The flanged outlets ship with 8-32 screws that grab the enclosure well with a good tap job. We also tie the wire back so that heat can escape cleanly.



Power for the main contactor from the inlet. In this 30a example we are using 10 gauge wire. In the first large screw of the contactor, there is also a 14 gauge wire that will run to the switch and back to this contactors coil for the main power control.

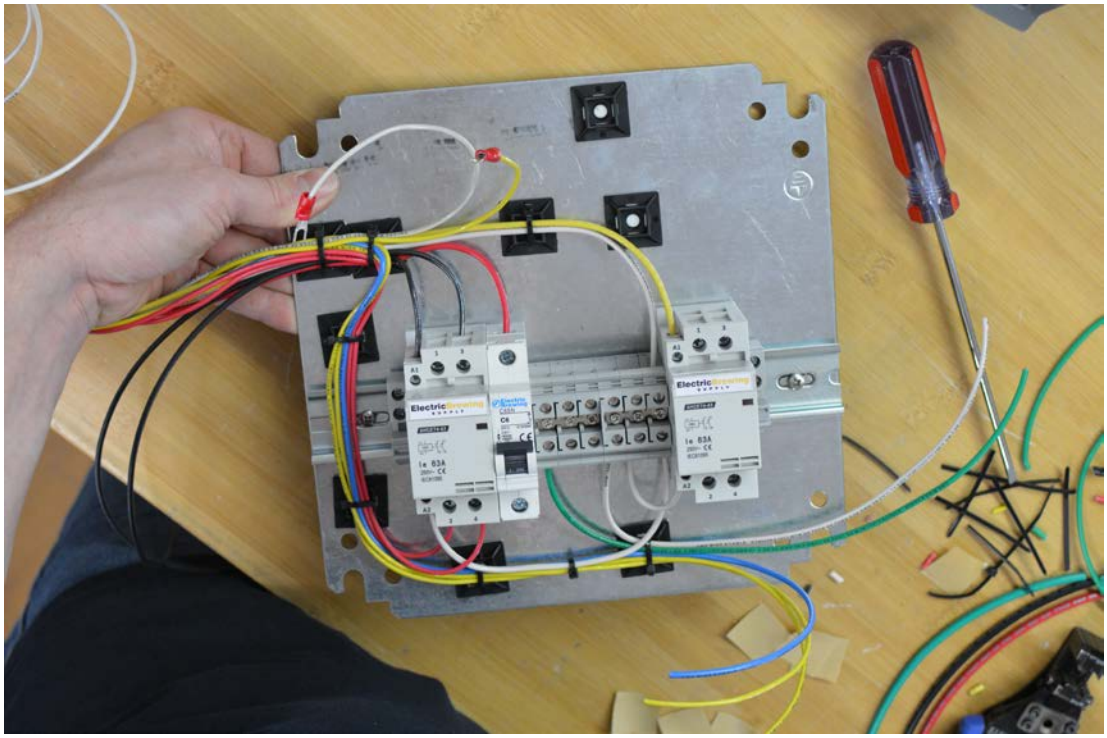


Here is a finished 30a BCS door, wired. The yellow is the wire from the 2 legs of the element for the white LED, as is the orange. In the 30a, the wire from BCS outputs 0 and 1 go directly to the SSRs on the top heat sink.



30a BIAB Stages

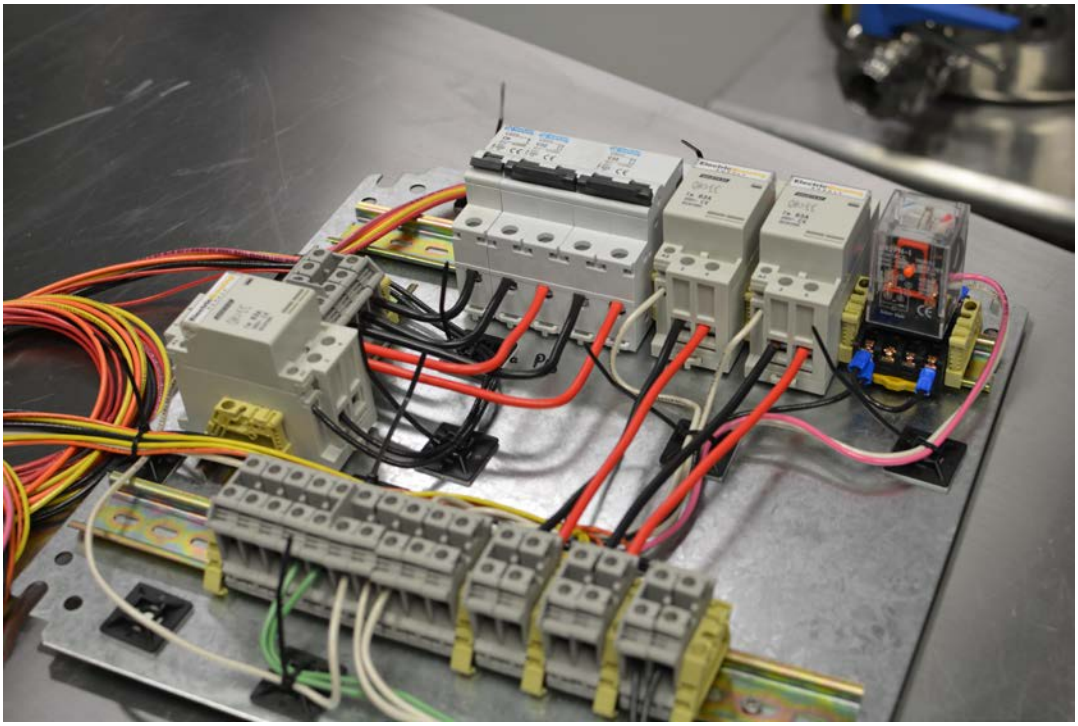
BIAB Sub Panel wired and ready



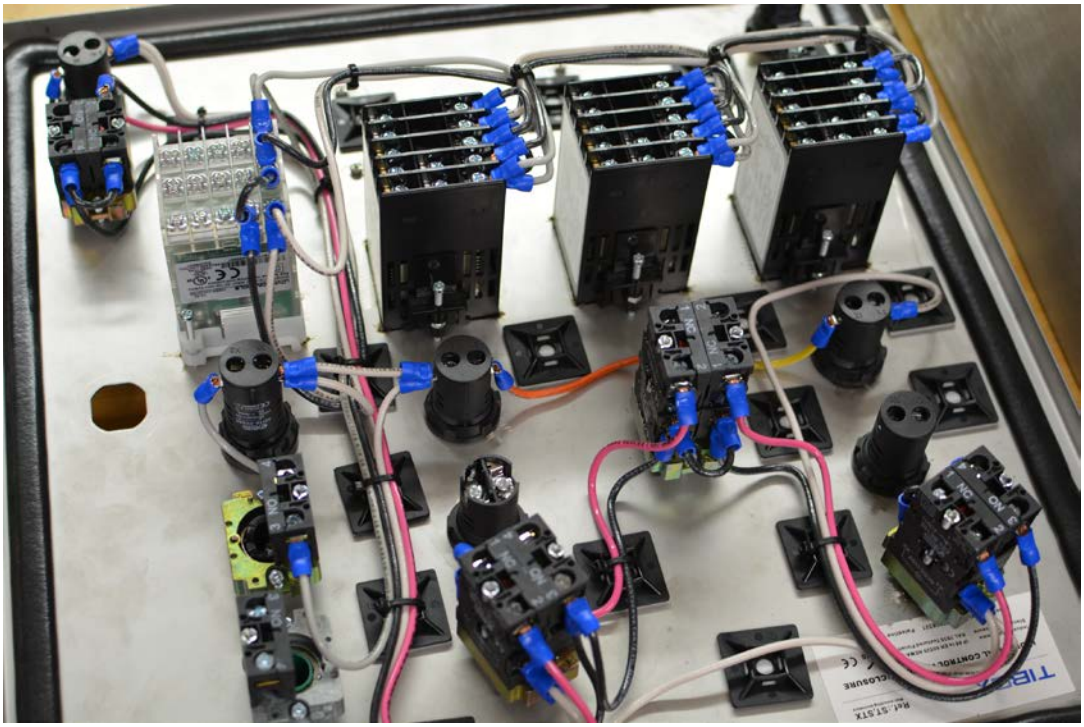
BIAB Door ready

30a PID stages breakout

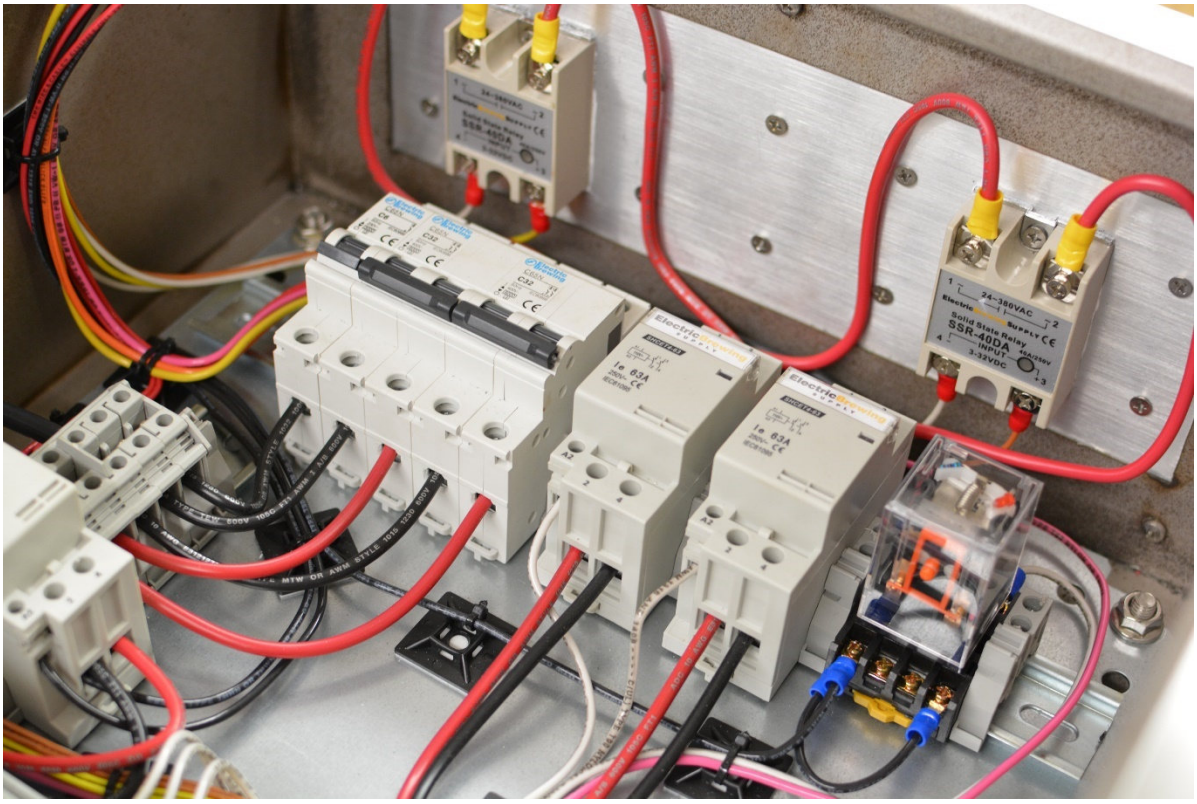
PID Sub-panel wired

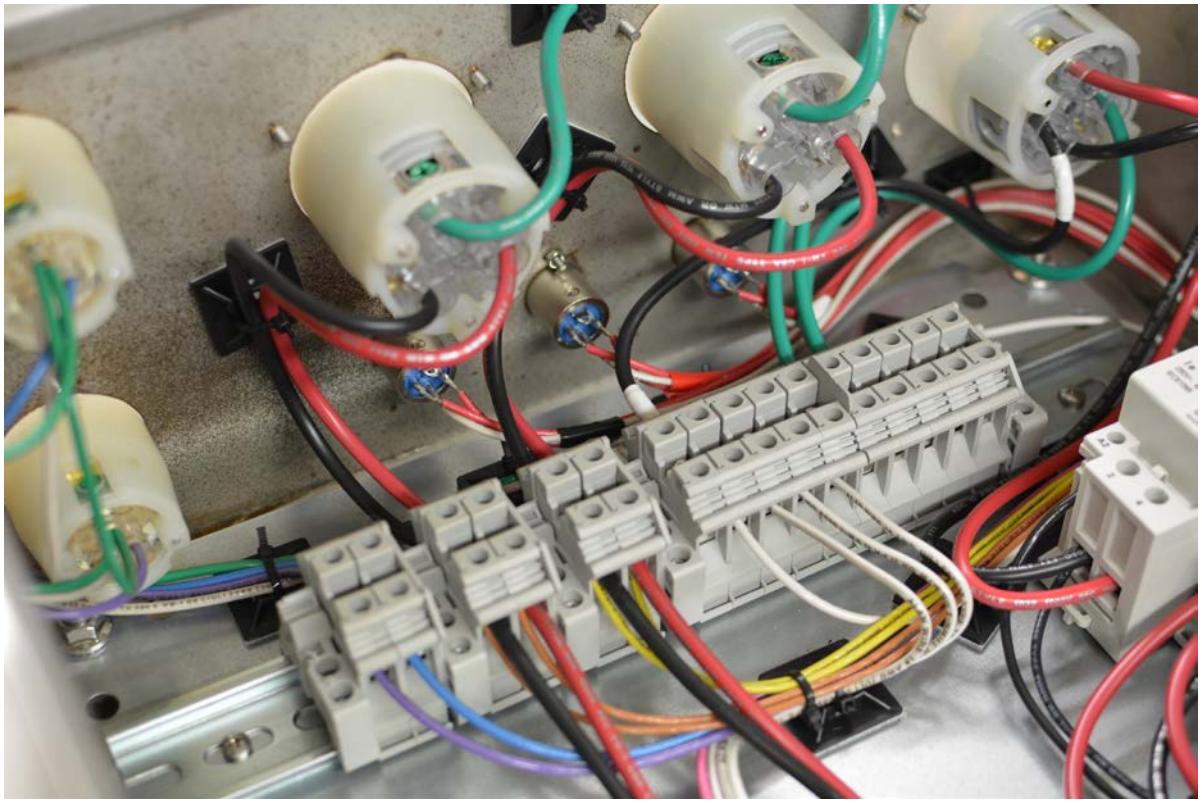


PID 30a Door wired up and ready

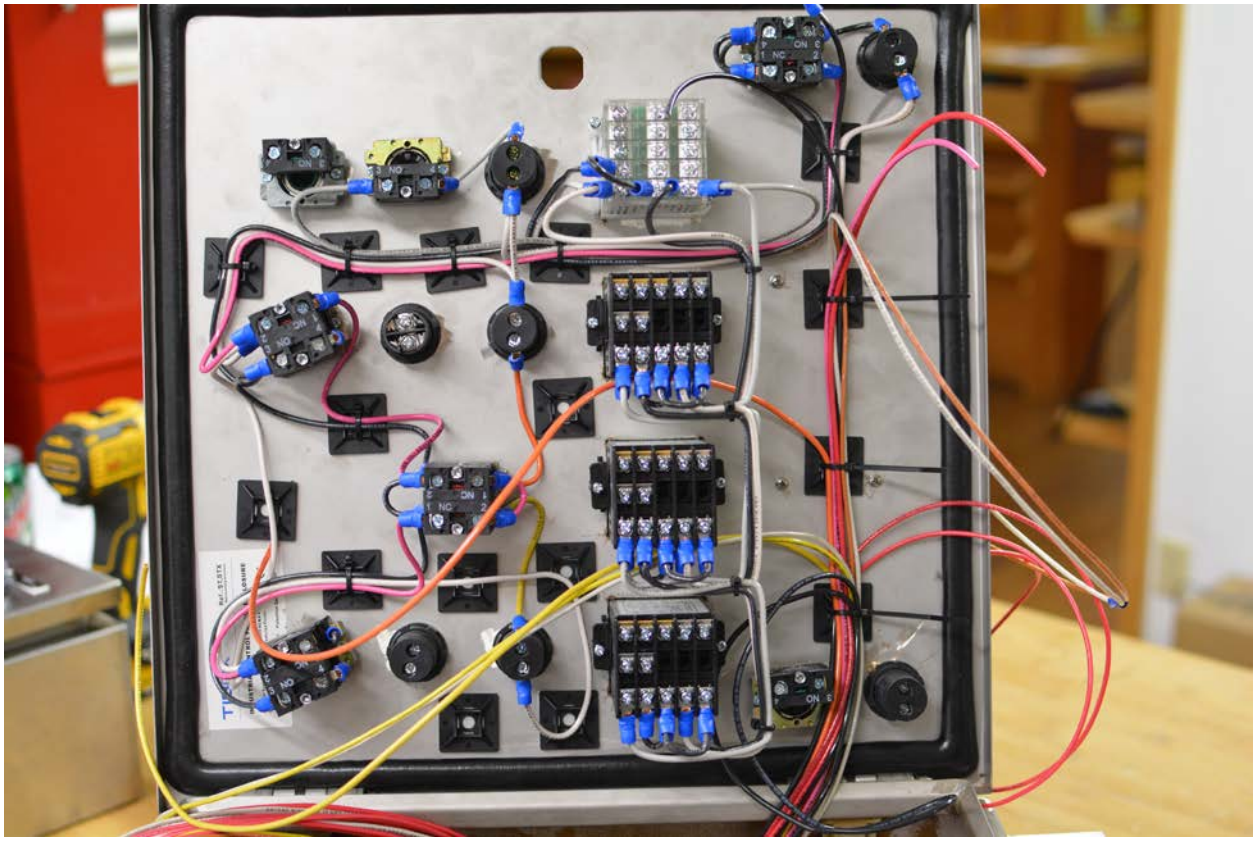


PID Sub Panel wired in box





Merging the door and box together.



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Temperature Probes

Once your panel is assembled, you are approaching completion. There a few quick projects to finish up the build. The key step is your temperature probes. For those who elect to use it, the complete kits ship with appropriately sized braided poly sleeving. While the sleeve may not serve a significant practical purpose, it does help give your setup a polished, finished look. For those using the standard BCS with 8 foot lead, or in the case of PID, RTD temperature probes, a cut of 1/8 inch poly sleeving is included, whereas the BCS M12 cables will come with 1/4 inch. There will also be appropriate adhesive lined, heat shrink tubing cuts. The cuts supplied are intended to be cut in half for each probe, one half for each end. The heat shrink reduces the amount of walking around the poly will do. There is often different colors as well, for easy identification.

The first step is to slide the poly on the wires. This is done in similar fashion to playing with a Chinese finger trap. The first inch or two will go smoothly on, but from then on, you must pinch the wire side, slide poly towards the pinch, pinch the poly side on the wire, then let go on the first pinch, then repeat.

Once the poly is on, slide your first half of heat shrink on, then slip the cover of the XLR on, then slide the second cut of heat shrink on. At this point it is recommended that you solder the wiring to the XLR connectors, then heat and secure the heat shrink. Let the heat shrink cool completely before sliding the XLR cover up the end for the finished look.

When soldering your wires, you need to ID the following:

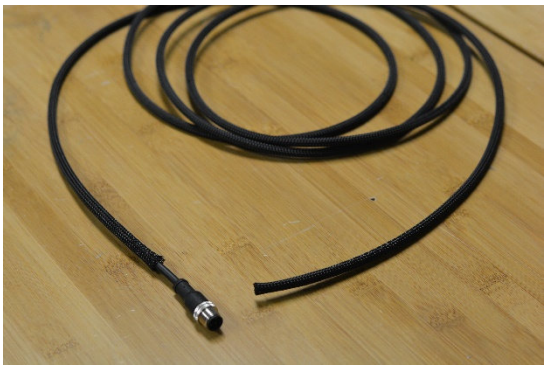
BCS will have 2 and 3 wire cables, in either case, only 2 are conductive, most often the Blue and Black wires. There is no polarity to the wires, therefore you can connect either color to the input or GND.

PID will have 3 conductive wires in RTD probe cases, it is important to know which are connected to which pins. RTD probes will have 2 red and a white wire. It's important to know which pins you use so that you can insure the PINs match up inside to the correct pins on the PID unit.

Assembling a BCS M12 Temp probe cable

The finished product should resemble something like this, with a short portion of heat shrink coming from the XLR and the balance holding the braided poly in lock at the M12 end.

1. Add the braided poly

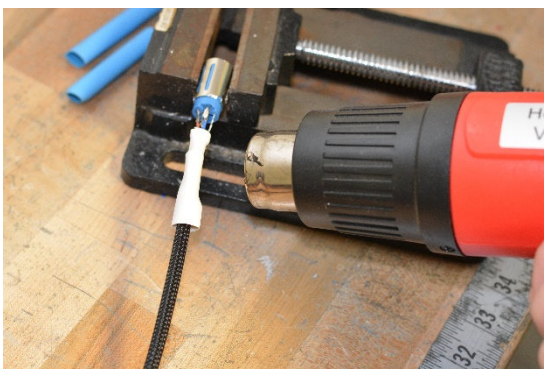


2. Cut the 4” heat shrink in half

3. Put heat shrink and XLR on cable

4. Solder black and blue to pins 1 and 2

5. Apply heat to heat shrink at each end of the cable.



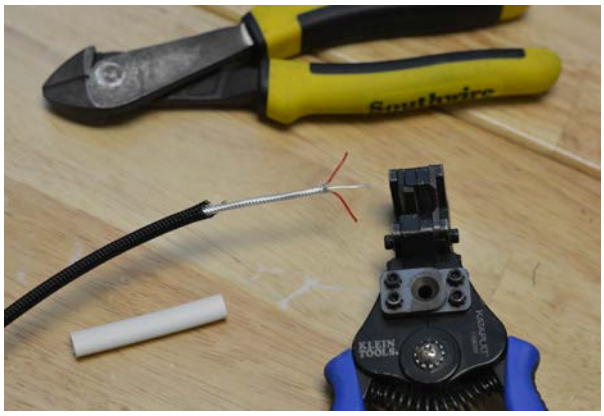
Assembling a PID Temp probe cable

For the PID cables, a lot of the process is similar, but one big difference is you need to keep track of the 2 red versus white wires, as this is key when you wire the probes up. Most often, 1 and 2 are red, and 3 is white to keep it straight forward.

The kit ships with a complete cable, but we're going to modify it because of 2 reasons, we're adding the black poly sleeve, and past experience has shown the panel mount side has extremely short tail runs.

The first step is to unscrew the hardware from one end, exposing the soldering. The snip the 3 wires at the solder point. The next step is to slip on the poly sleeve.

Once the poly sleeving is on, take the 4 inch piece of heat shrink and cut it into 2 pieces. Typically one slightly longer than the other. The longer will go on the XLR end, the shorter on the probe end. Slide the shorter on first, and unscrew but don't detach the clamping portion of the probe connector. Slip the heat shrink between the ears and under the clamp portion. With poly slipped as close to the rubber portion, heat the shrink secure it all together.



On the other end, cut back some of the braided poly, about ½ inch maybe, it can be slipped further down. Strip back some of the outer cover and snip away the shielding to expose some extra wire. Then strip the ends of each.

Solder the 3 wires to the XLR after you slip the cover portion and second piece of heat shrink on. Typically we use pins 1 and 2 for the Reds and 3 for the white wire. We can then easily match this to the 3 wires on the panel XLR side. Slide the heat shrink in place, heat to secure. Let cool some and then slide the XLR cover on. Screw, and that should complete the probe.

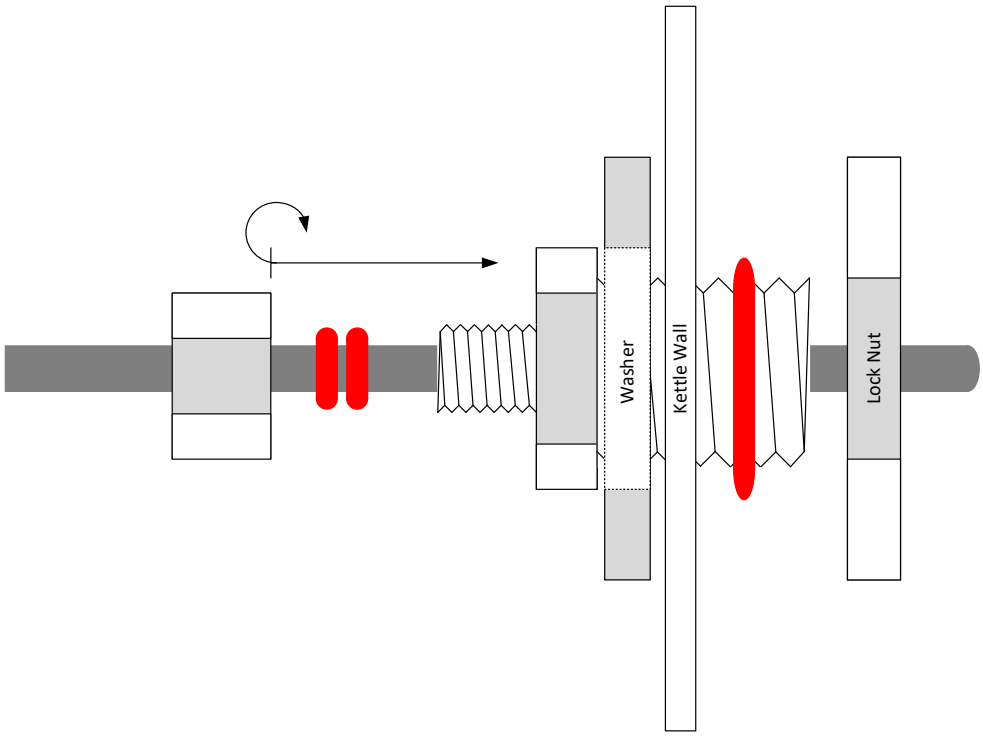
Mounting temp probes

While there are many arguments one way or another as to where to mount your probes. There are 2 types of mounting points and where you choose to use your probes will be left to you.

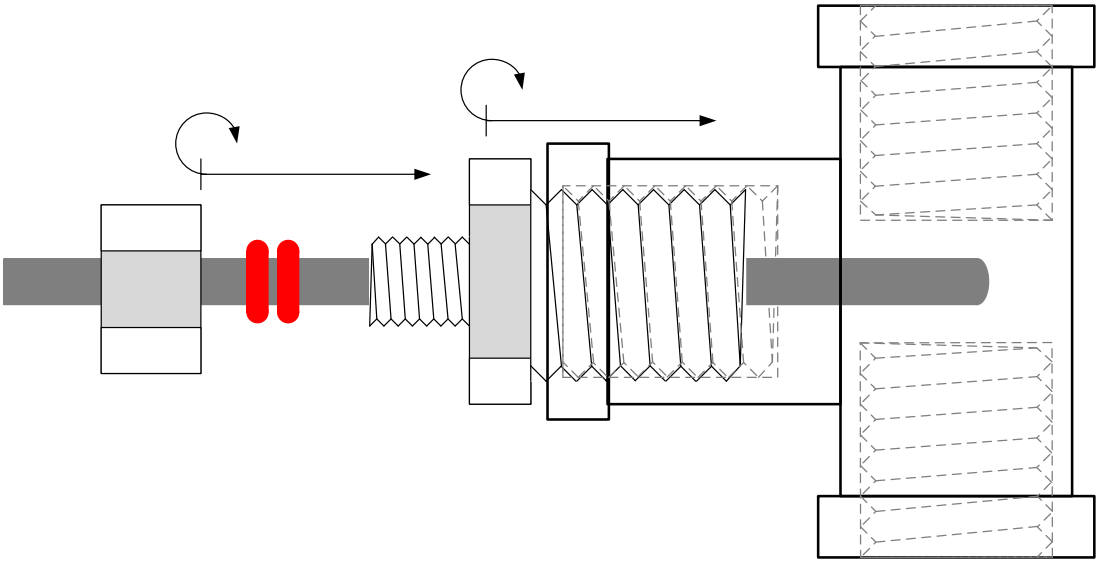
The usual mounting point in our system is on the walls of each of our vessels; however recently we've found the probe mount on the Mash tun from some manufacturers can actually be too high and ineffective. For this application we have begun using the probe in a T-fitting at the output of the HERMs coil prior to the wort returning to the mash. This way the temperature reading is reflecting the closest to the HERMs and showing the peak temperature of the Mash. It can be then left to your determination by trial and error how many degrees plus or minus you may need to be to hit your target temperature.

Recommend BCS Compression style mount to kettle wall

This isn't just an idea on how to approach the kettle mounting, this served well for the past number of years. With the occasional o-ring replacement when you do a heavy clean after a number of brews. These pieces should be included with your complete kit or assembled panel.



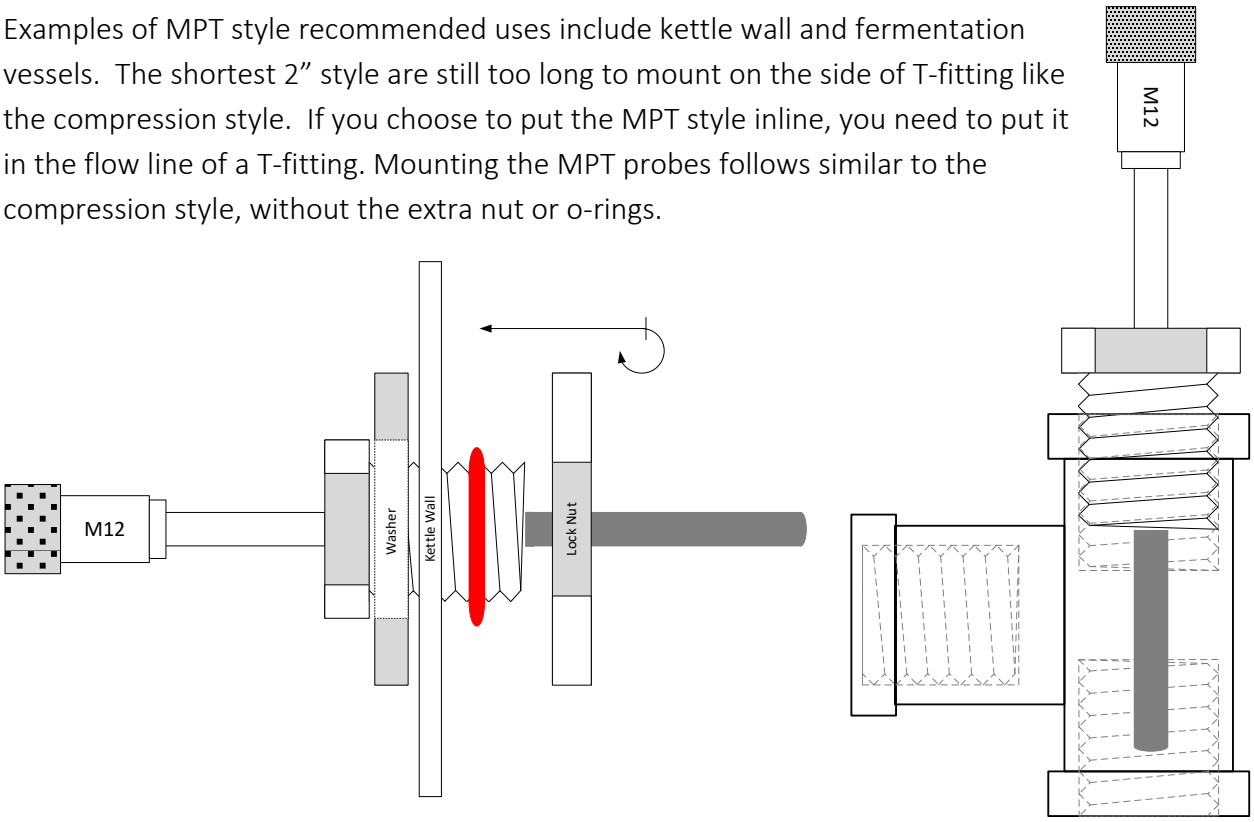
Recommended BCS Compression style mount in plumbing



MPT Style of BCS Probes

Today there are several choices for BCS temperature probe styles, while the compression may be the most flexible, there are some that a purposely designed for clean application. The straight, compression style will work for you in the kettle wall and in the plumbing at any depth you wish along the 4 or 6 inches of probe. The alternative are welded MPT and Tri-Clamp options, while these are an extremely clean finish, they are more specific to their applications.

Examples of MPT style recommended uses include kettle wall and fermentation vessels. The shortest 2" style are still too long to mount on the side of T-fitting like the compression style. If you choose to put the MPT style inline, you need to put it in the flow line of a T-fitting. Mounting the MPT probes follows similar to the compression style, without the extra nut or o-rings.

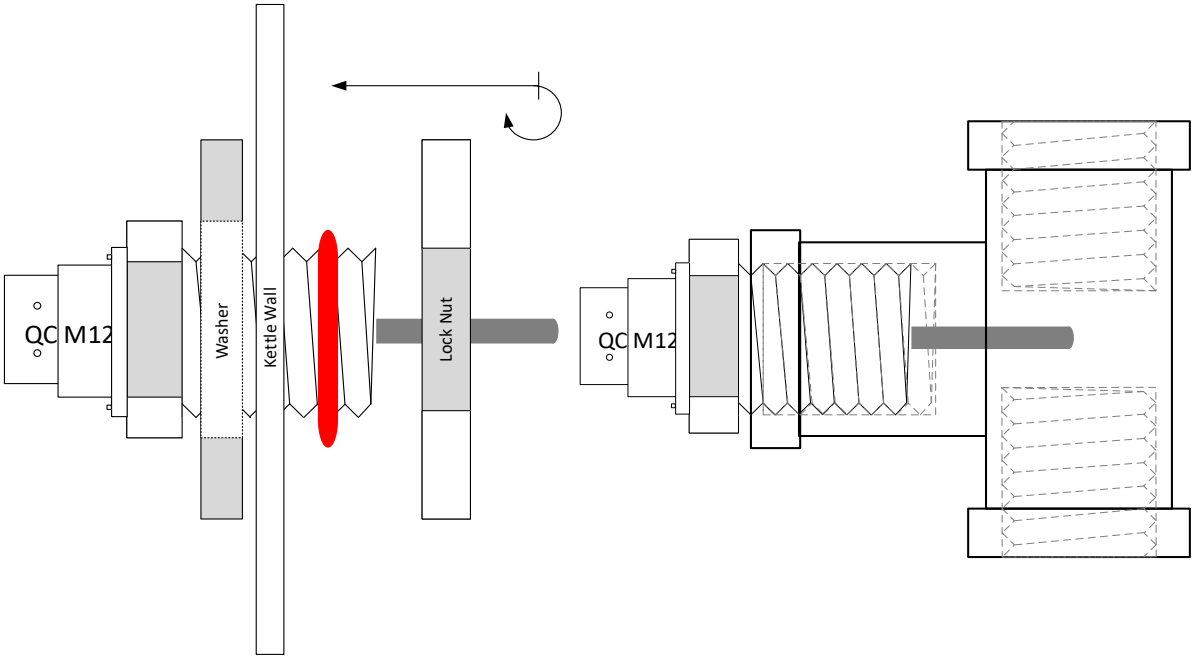


Tri-Clamp style BCS Probes

The tri-clamp/sanitary probes on the other hand work well in a number of applications relating to tri-clamp fittings. The shortest, 3" style probes can used in a tri-clamp inline fitting similar to the compression, or they can be used on kettle walls, it is up to you.

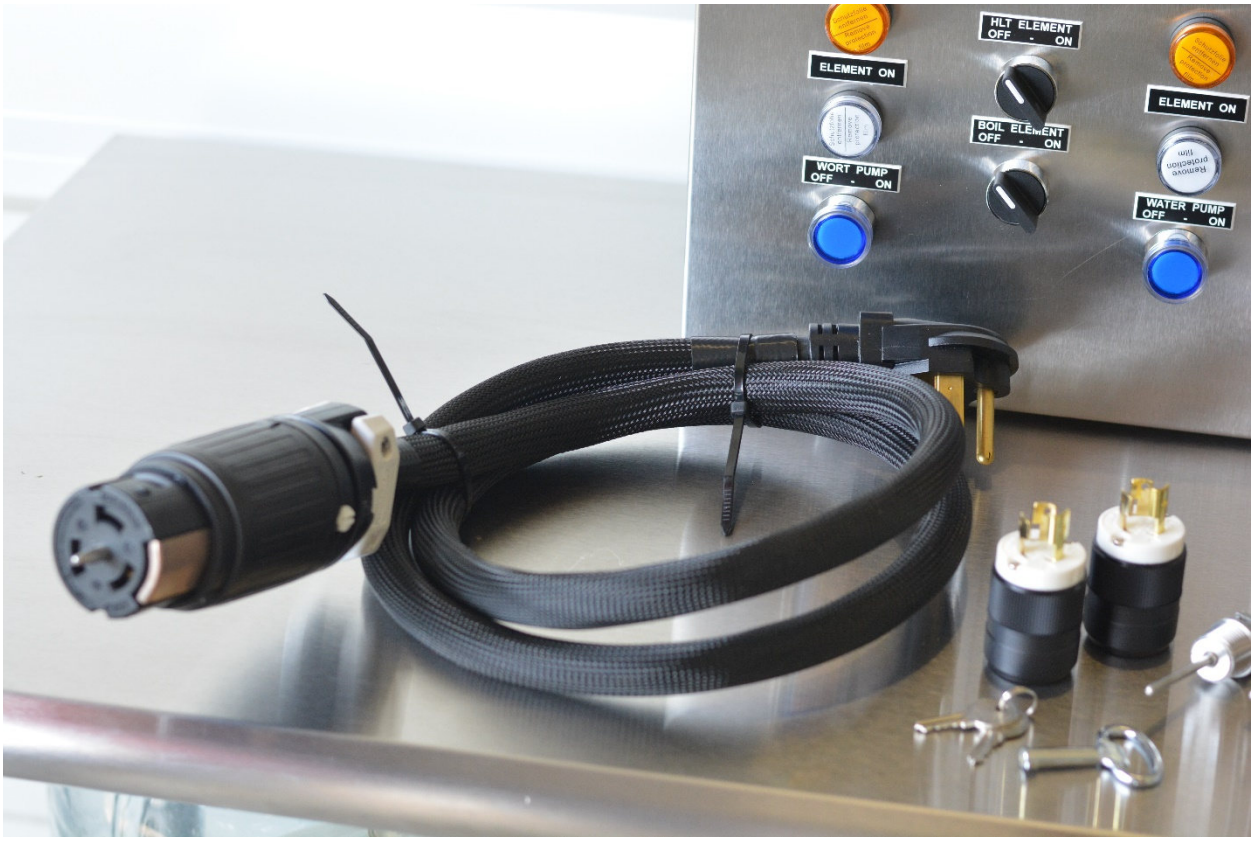
Mounting PID Probes

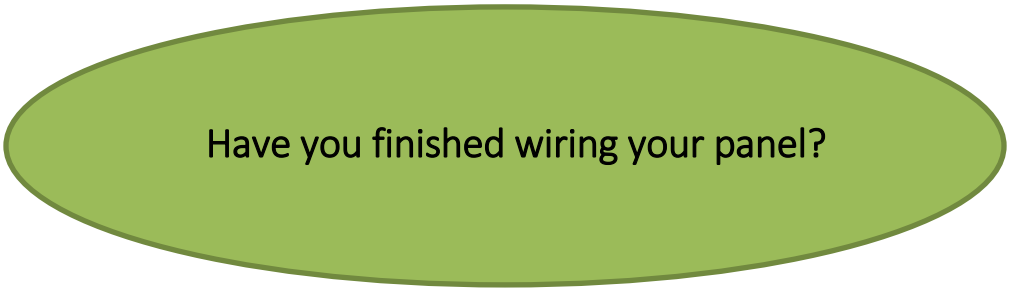
Similar to the BCS probes, the PID probes use the locknut, o-ring and washer, without the need for compression if you mount to a kettle wall. If you have the 1.5" temp probe, these will also easily mount in the side of a T-fitting similar to the mounting of the BCS compression fitting.



Power Cable

For the power cable we also add 3/4 inch braided poly, but use a high quality electrical tape to secure it. We found the heat shrink would not hold on long enough to be effective. Here is our 50 amp power cable, using a 6' range cord and the CS6364C connector.




Have you finished wiring your panel?

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Now that you are wired up, it's time to setup you system.

For PID skip ahead as the first portion relates to BCS.

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The basics of BCS

Now that you have a control panel all wired and tested for connectivity, it's time to fire up and login to your BCS for the first time.

If you aren't a networking guru, no worries, as the BCS is relatively plug and play.

The basic steps you need are as follows:

1. Connect to your home network if available
2. Using BCS Finder (unless you know your network well) locate your BCS IP address.
3. Type the BCS' IP address into your favorite internet browser's address box.
4. Configure your BCS temperature probes
5. Configure your BCS outputs and, if any, inputs
6. Create your first process. Then more if you choose.
7. Then Brew!

Advanced Configurations

For the more advance how to on setting up your BCS, please refer to http://bcswiki.ebrewsupply.com/. For the purposes of this manual, we are going to help you hit the ground running.

What you need to know about BCS Network Connectivity

By default, the controller attempts to obtain an IP address from a DHCP server (router). After about 2-3sec, if no DHCP server is found, the board defaults to a static IP address of 169.254.0.63 when in factory default.

For both Networked and Direct Connect options, either a straight-through or cross-over Ethernet cable can be used. The BCS has an Auto-MDX feature and the system adjusts automatically, so it does not matter which type of Ethernet cable is used.

Directly Connected

*** This method is not recommended or supported as it relies on too many uncontrollable variables ***
Attach the Ethernet cable directly from the controller to your PC, and power up the BCS. Type: http://169.254.0.63 into your host's web browser URL line, and you will connect to the unit. Some users may require additional setup if connecting directly, see Additional Network Setup.

Networked

Attach the Ethernet cable directly from the controller to the router, and power on the BCS. Always connect the Ethernet cable before powering up. As the BCS powers up, the router will assign a unique network address to the BCS in order to identify it on the network. This is the IP address that we will use to interface with the BCS, by typing that address into the address bar of a web browser.

BCS Wireless network connectivity

If you have opted for the included wireless network router, connectivity is a matter of a few steps. The wireless adapter by default ships as a wireless router, this means the network port on the unit is looking for a modem, therefore when you first connect the BCS it communication is not possible.

Setting up a standalone wireless BCS

To setup a stand alone wireless BCS system similar to what we would ship, you must first plug in the TP-Link router. Included in the packaging will be a note card with SSID and password info; have this handy for an easier process but don't worry if you can't find it. On all TP-Link routers, the manufacturer attaches a label with the SSID and passwords as well.

After plugging in the TP-Link router, log on to the wireless network with your laptop. The network, from the factory, will begin with TP and be followed by an alpha numeric combo. The password by default will be a combination of 2 unique alpha numeric values followed by the alpha numeric values of the SSID. For example, wireless SSID is TP_27C433; the password would therefore likely be something like 2727C433. All passwords are Case Sensitive, therefore watch your caps lock.

Once logged on, point your web browser to 192.168.0.254. Username is Admin and the password is password.

Once in the admin portal there are a few key settings to make sure and change, while 1 or 2 optional. Priority changes are Working Mode and DHCP Reserved Address list. You can also update the wireless settings per your preference.

Under DHCP Server Reserved addresses, add a reservation for your BCS unit. To do so notate the MAC address labeled on your BCS unit, and enter this into the new reservation. Typically, the MAC address will start AA-00- and go from there. Then enter an IP address that matches the router's with exception for the last grouping; for example 192.168.0.50. Click save.

After adding the IP reservation, and making any changes to the wireless ID and passwords, click on Working Mode and select AP – Access Point. Once you hit save the router will reboot. Give the router about a minute to restart, then with the BCS powered off, connect it to the wireless adapter, power it on, and proceed to point your computer's web browser to 192.168.0.50. You should be set to commence setting up the BCS from here.

Setting up a remote wireless client

To setup the BCS as a remote wireless connected device, take your router through the automated wizard for Client Mode. After it's configured, and has rebooted, giving a blue led

glow, plug in your BCS and power it up. After a few moments the BCS should obtain an IP address. From here proceed with BCS Finder or Fing.

Finding the BCS's IP Address

BCS Finder (available at: http://bcsfinder.ebrewsupply.com)

The BCSfinder Utility broadcasts a special packet on the network, and each BCS responds with its IP address. This address is then displayed in the BCSfinder GUI. This is the easiest way to locate your BCS.

Router Connections Table

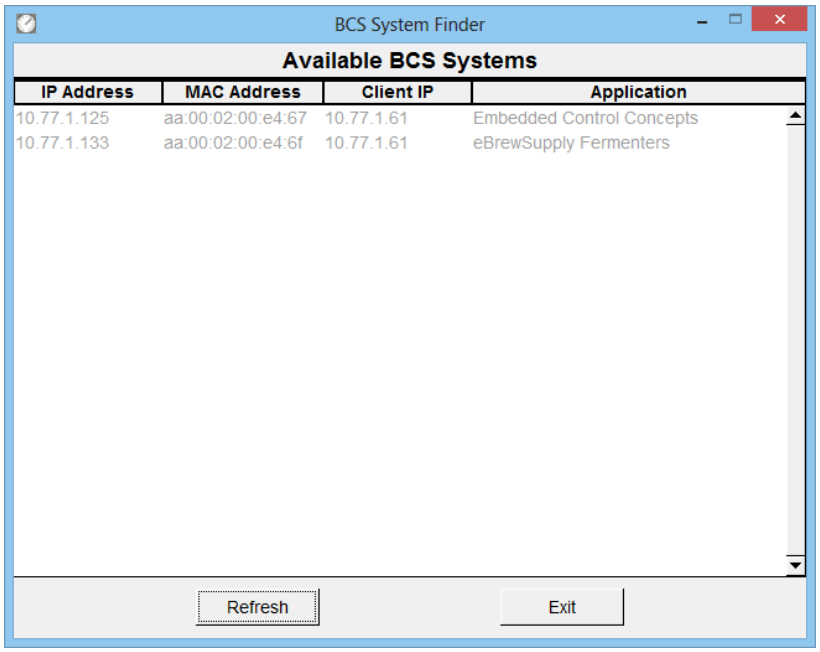
Another method to find the IP address is to log into the router and locate the BCS in the routers 'Connected Devices' list. Most have a default IP of 192.168.0.1 and will require a user and password (default user:passwd is usually admin:admin). In the router's status menu you will see a setup page for Network Settings and a list called -Dynamic DHCP Client List. This will allow you to see all of the attached devices and associated IP addresses on your network. The connected BCS will be listed in this table, identified by its MAC address which is printed uniquely onto each BCS label. Once you locate the BCS's IP address, type it into the URL field on the browser.

Getting Started

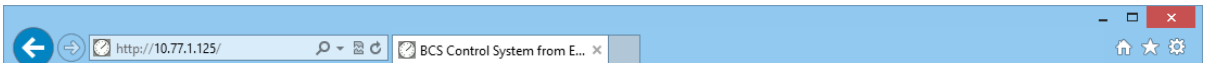
Once you have plugged your BCS into your home network and fired up your computer, point your web browser to http://bcsfinder.ebrewsupply.com. Download the utility, as this will make your life much easier moving forward.

Turn on your BCS unit, watching the unit's network LEDs. If they both come on, or at least one comes on, you should be in good shape to move forward. If no lights come on, troubleshooting will be necessary.

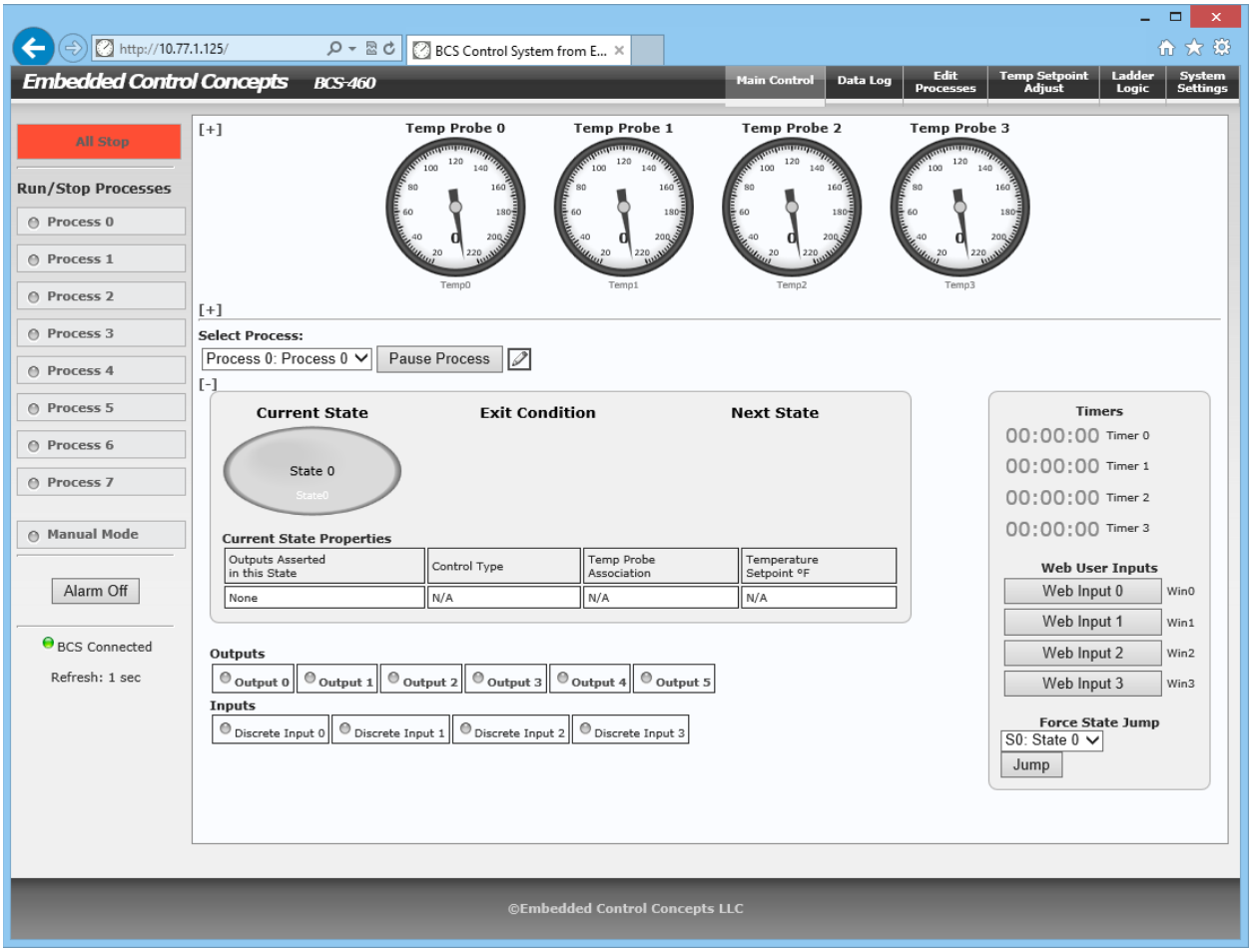
If lights are on, then load up the BCS finder application. You will get a screen that resembles the following.



Ignoring the fact that there are 2 units in this example, you can see that there are 4 points of information visible; the first column is the IP address of your BCS unit. This is the data you want to plug into your web browser's address bar.

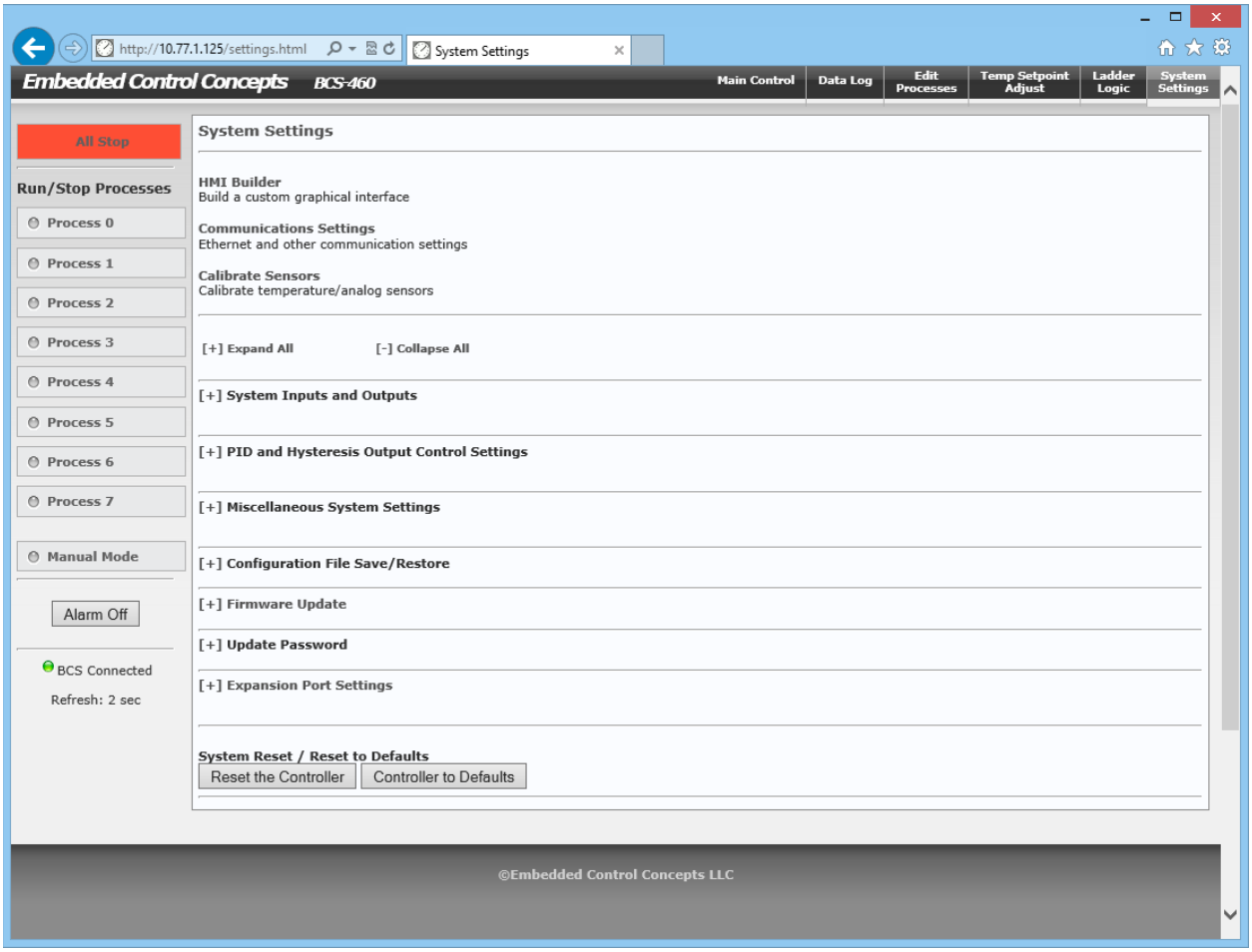


The resulting screen should resemble the following:



In the top right hand corner, select **System Settings**

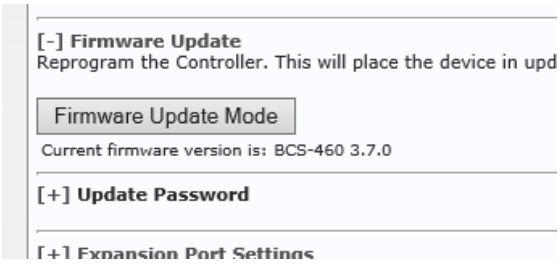
System Settings : Firmware Update



You can choose to [+]Expand All or you can focus on a few select categories.

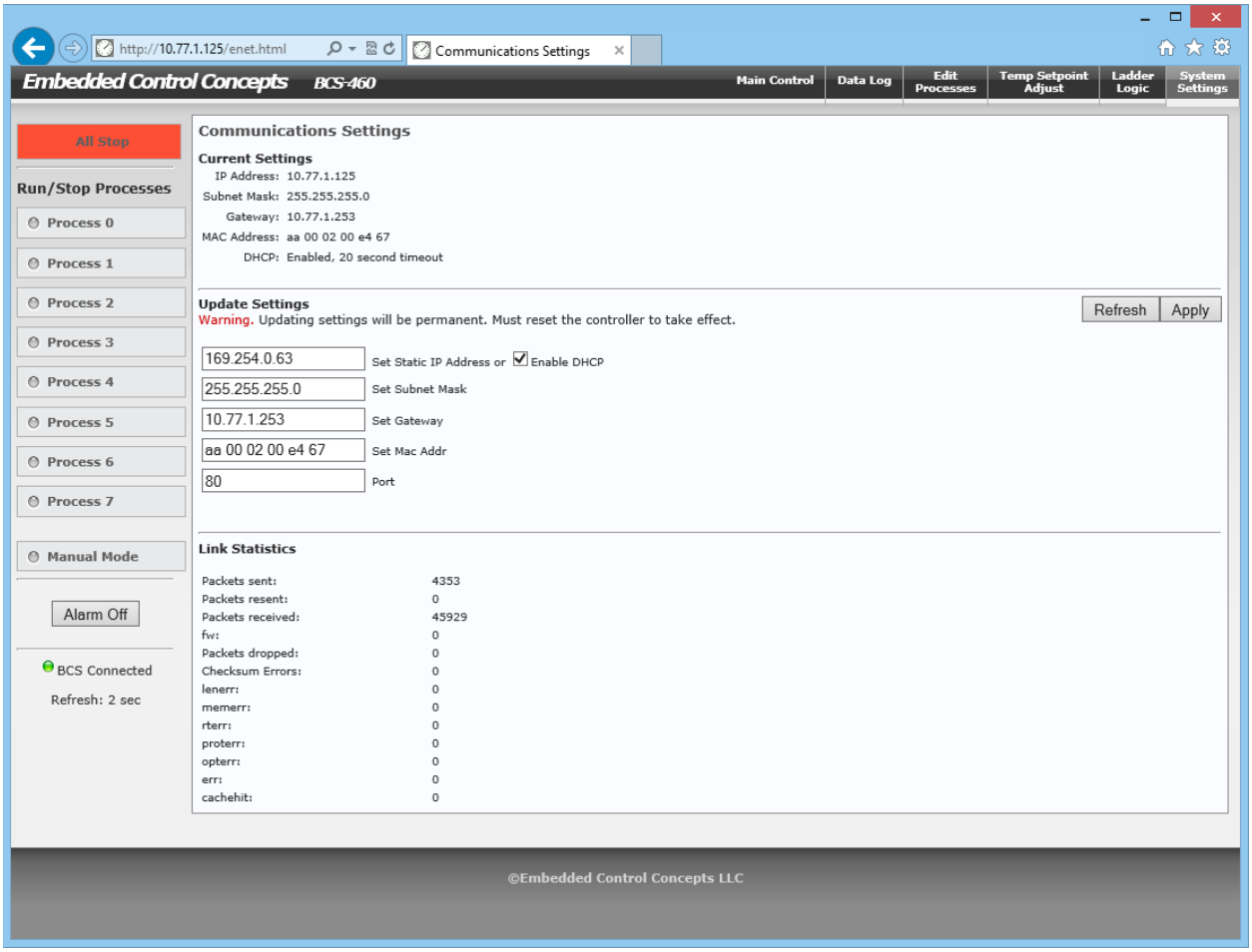
The first recommended step should be to confirm you have the latest firmware. If you received you BCS recently, chances are good you are current, but it doesn't hurt to look. The reason for this is simple, if you are not using the current firmware, but new temp probes, your temperatures will be off. Additionally, any settings you have are lost when you update, so update first, set once.

By clicking on the **[+]** beside Firmware, you will expand the screen. If the firmware is out of date, point your web browser to http://bcsupdate.ebrewsupply.com for more instructions, otherwise, continue on.



As of 5/1/13, version 3.7.0, release 2/20/13 was the latest firmware version.

System Settings: Communications Settings

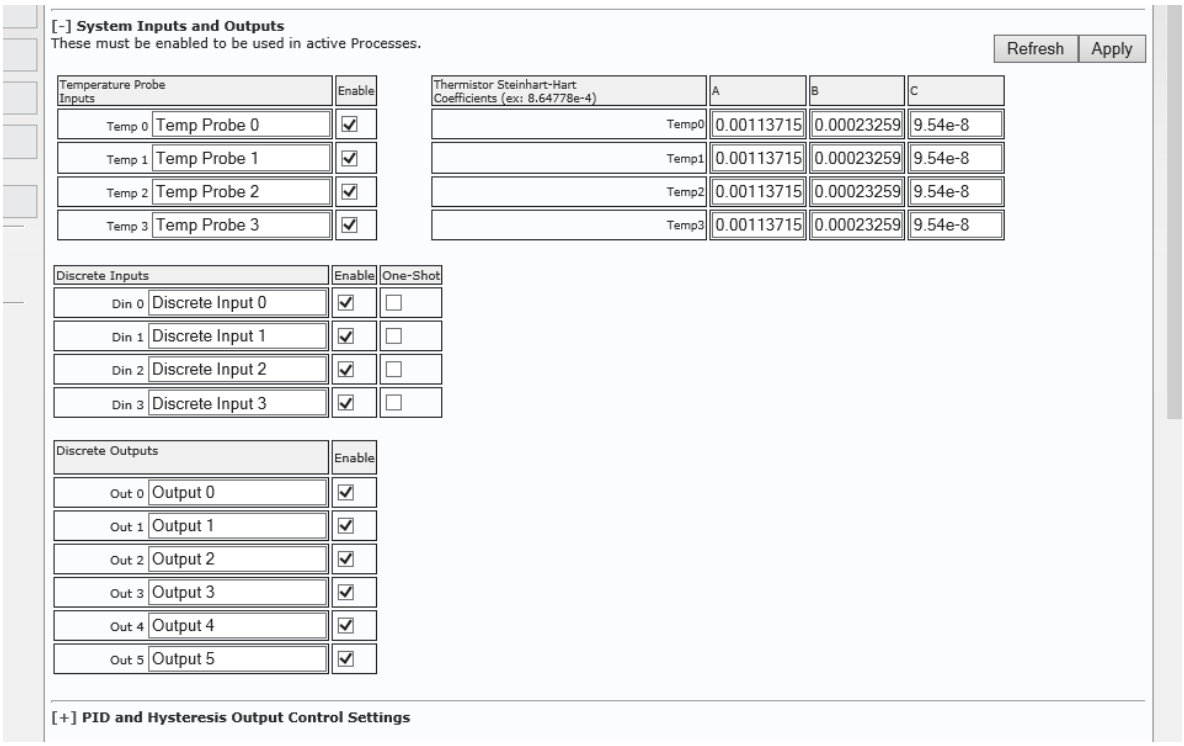


From system settings, once you're firmware is updated (if needed), go into Communications Settings. We want to lock the IP address into one that is easily remembered; otherwise each time you brew, you will be looking for the BCS unit.

To set what is termed a Static IP address, that you can recall easily, uncheck the "Enable DHCP" check box. You then using the information from "Current Settings", fill in the Static IP address box with one that is easy to recall, but is also part of your network. Most popular network routers will start 192.168.0.XXX or 192.168.1.XXX. You will have an idea of which by looking at current settings. Subnet Mask and Gateway should be already set for you. Once a static IP is setup, click apply, wait a few seconds, then point your web browser to the new IP address.

System Settings: System Inputs and Outputs

When you click on the **[+]** beside **System Inputs and Outputs** you will get a set of tables like so:



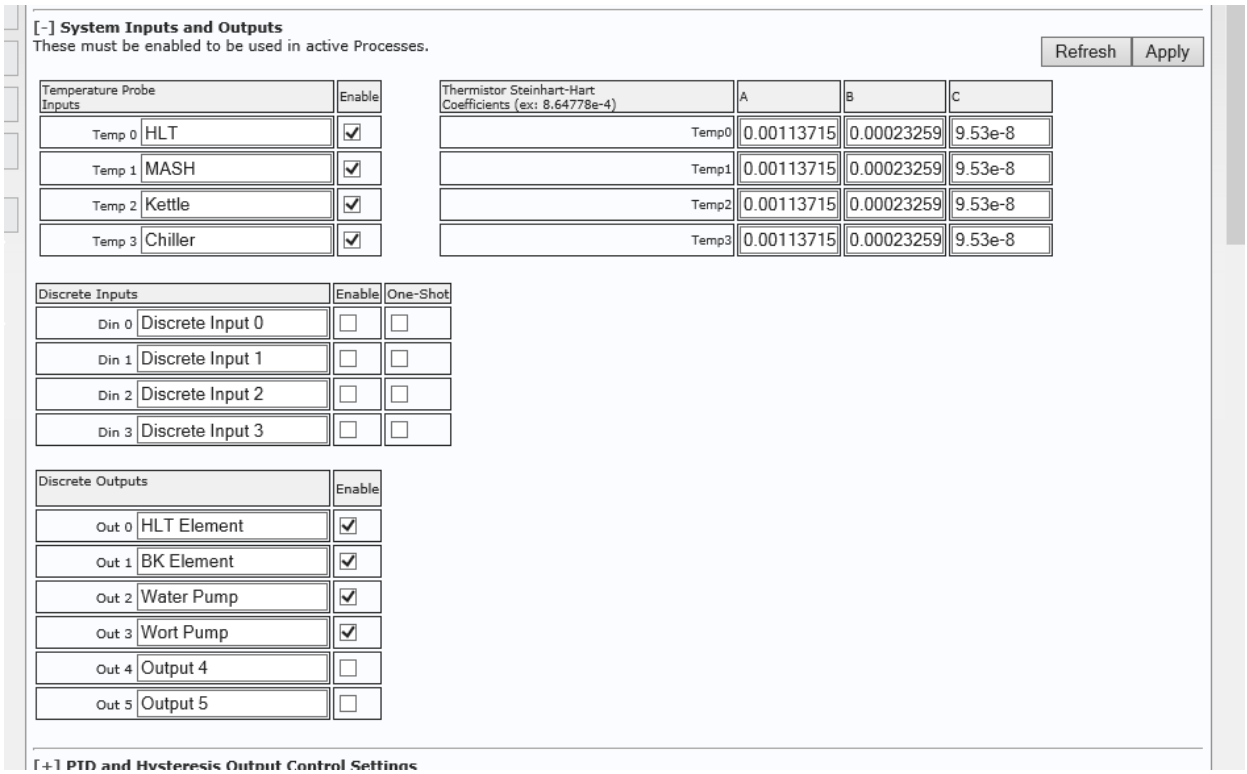
In the base BCS 50a and 30a control panel design, the only points of interest should be **Temp 0, Temp 1, Temp 2, Temp 3, Output 0, Output 1, Output 2,** and **Output 3**. If you purchased the temp probes after January 1 from Electric Brewing Supply or Brewers Hardware and you are using Firmware version 3.7.0 or later, your Thermistor Coefficients will already be correct.

For Temp 0 through 3 (through 7 in case of BCS 462), the input box allows you to name each temperature input. For this example, we'll use a HERMs configuration with the fourth temperature probe in our plate chiller for knockout. Therefore we set **Temp0** to **HLT**, **Temp1** to **MASH**, **Temp2** to **Kettle**, and **Temp3** to **Knockout or Plate Chiller**. Once these are set, click **Apply**, saving this configuration.

Moving down the settings, we can choose to uncheck "Enable" on the Discrete Inputs as we aren't using any, and therefore no reason to show them as an option later.

For **Discrete Outputs**, our main interests are **Output 0** through **Output 3**. These are the outputs on the BCS that we tied the SSRs to earlier when wiring the panel. Again, here we can also uncheck the "Enable" boxes for Output 4 and 5. For our HERMS setup we changed the names for Output 0 through 3 to **Output 0** = **HLT Element**, **Output 1** = **Kettle Element**, **Output 2** = **Water Pump**, and **Output 3** = **Wort Pump**. Again, click apply and save the configuration.

The end result should resemble:



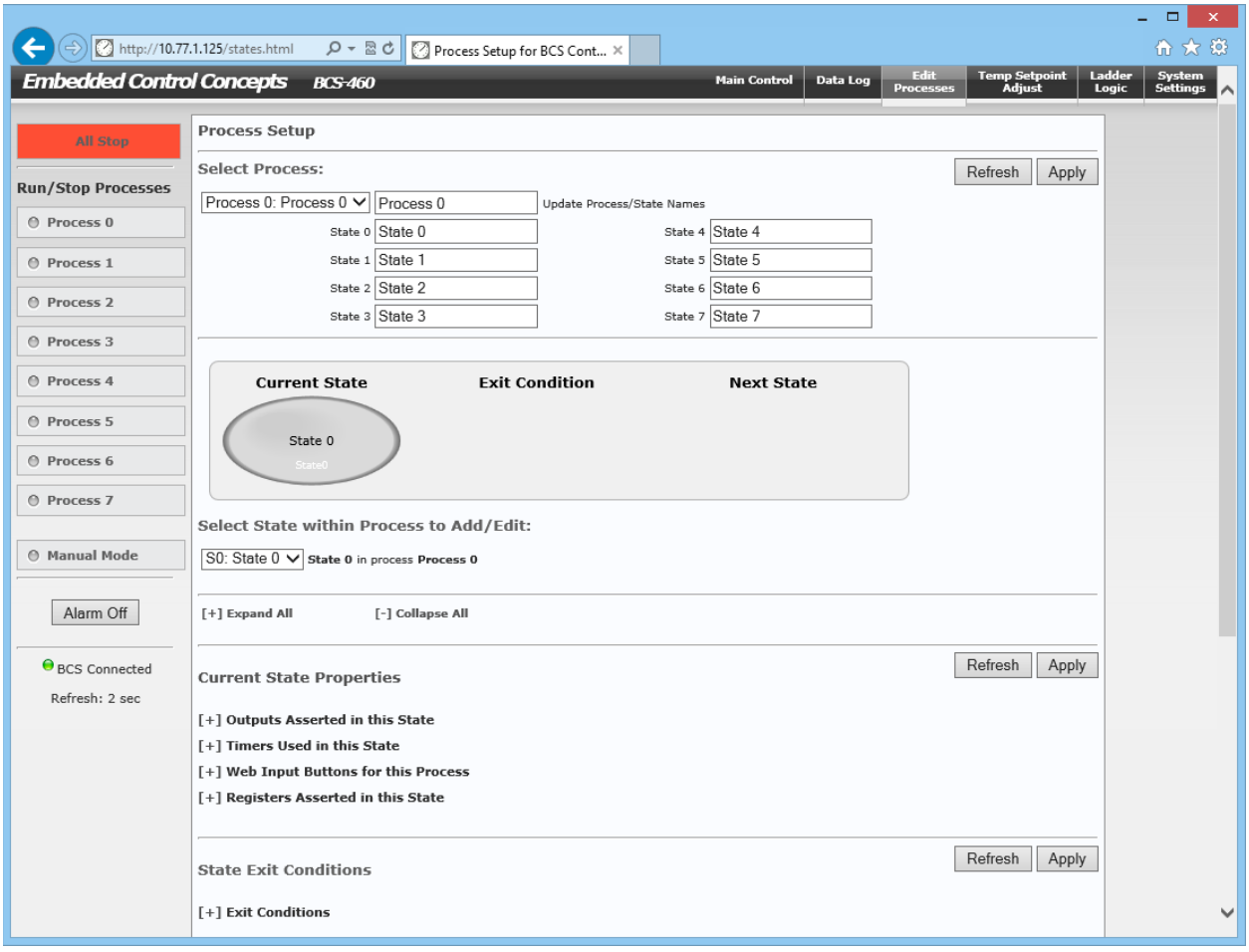
Your basic settings are now done. Let's create your first process.

Edit Processes

Now that you have configured your BCS, the key to using your BCS is your processes. These are the actual steps your automated system will take while you brew. Much of what you can do with these we will side step in an effort to give you the basics you need to get brewing.

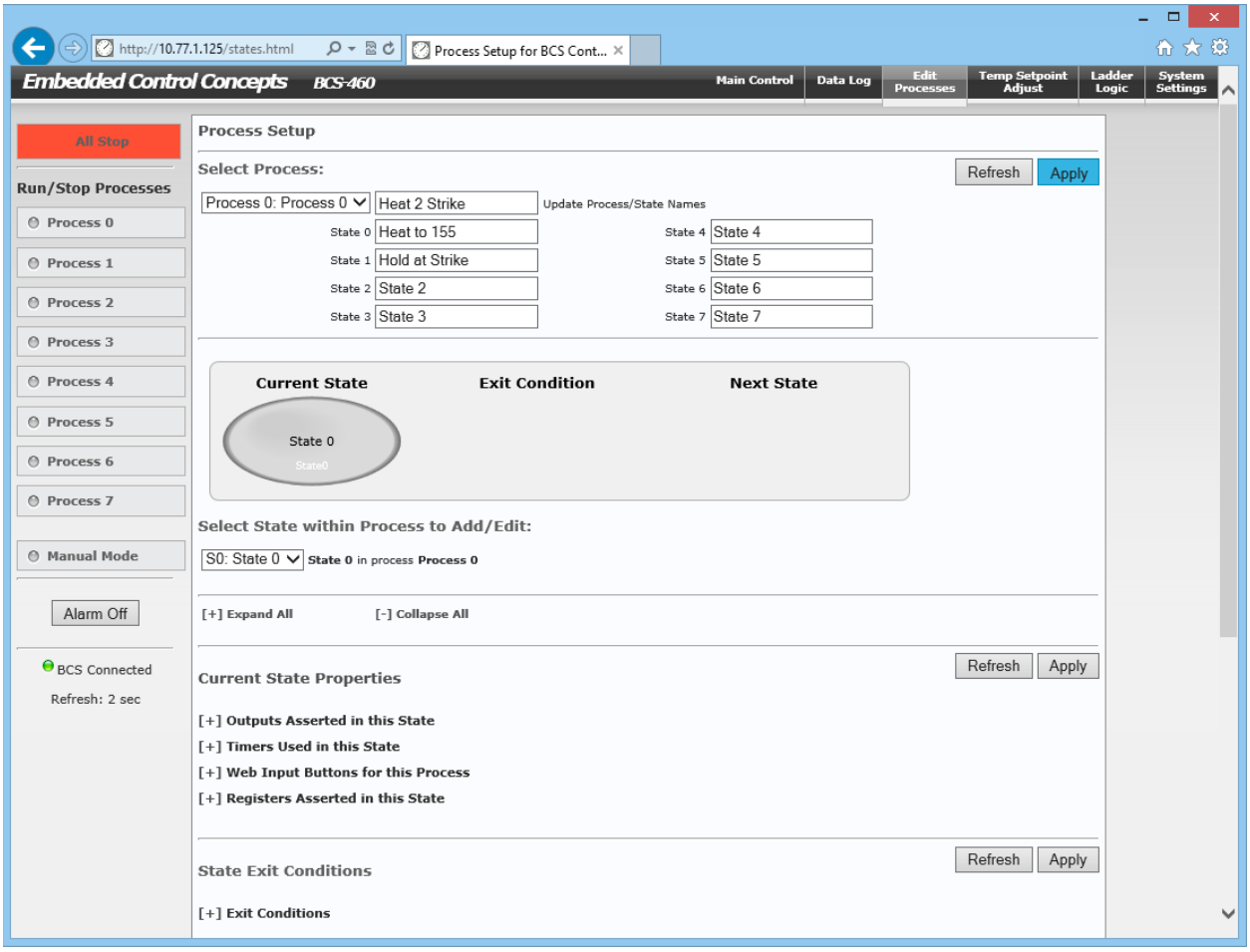
Our first process will be simple; the goal being to heat your water to strike temperature. For our own process, I usually put my strike water into my Mash kettle, and pump it through my HERMS coil which is submersed in the HLT. This may not be how you approach your brew day, and for that reason, you will want to adjust your process accordingly, but for demonstration purposes, we'll use my own.

When you click on **Edit Processes** at the top you will be brought to the following page:



Note the fact that everything is vanilla at the moment, no name for the process, as well as for any of its states. We're going to change this by starting with naming. I usually name first as it helps lead the process setup later.

Edit Processes: Naming States



As you can see, this process will have 2 states, “Heating to 155” and “Hold at Strike”.

Once you apply, you will see the state Drop down update with the names, telling you where you are in your process:

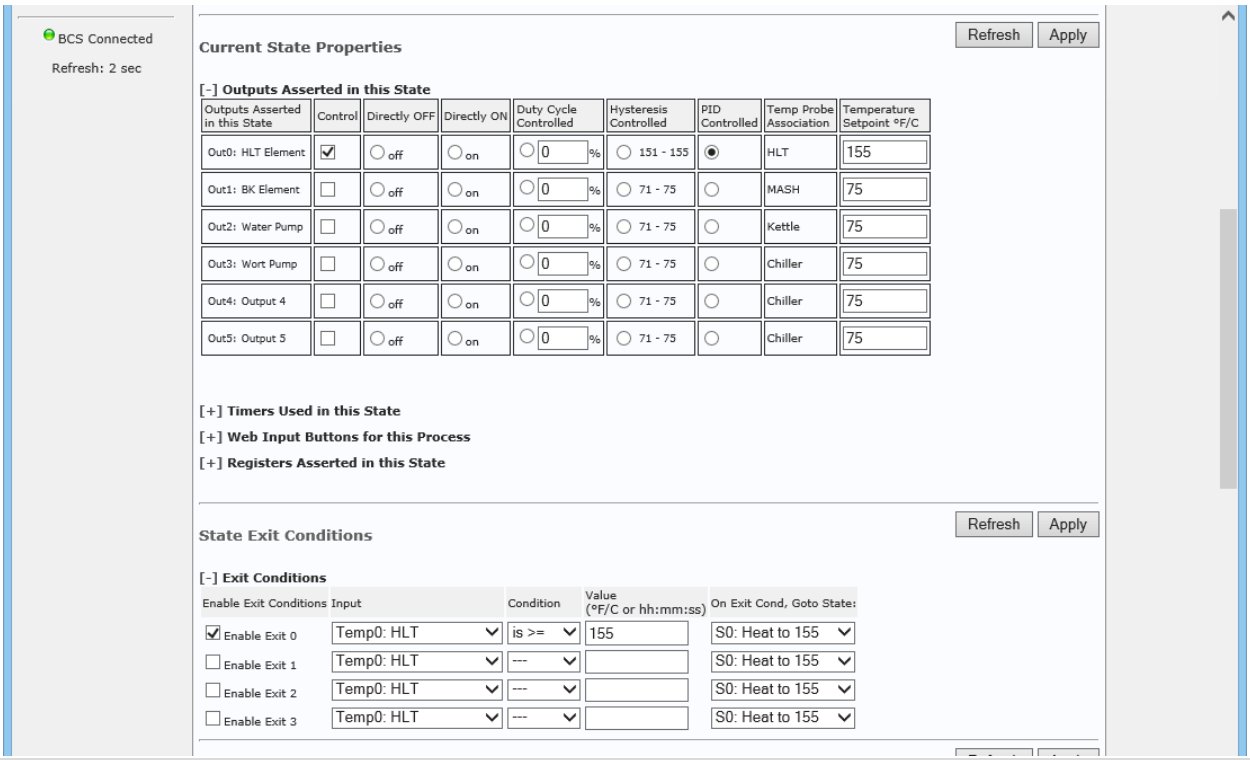
Edit Process: Current State Properties: First State

In Current State properties, the easy thought approach is: "What do I want on? How long do I want it on? At what temperature do I want to be". For the case of heating to strike, we want the HLT to heat the strike water to 155 degrees and then alert us so that we can add our grains to the strike water. Simple, right?

In order to accomplish our goal, the steps for **Heat to 155** state are:

1. Click the square checkbox beside **Out0: HLT Element**, enabling Control
2. Click the radio (circular) button under **PID Controlled**
3. Change Temperature setpoint from default of 75 to **155**
4. Scroll down to Exit Conditions
5. Click the square checkbox beside **Enable Exit 0**
6. For *Input* **Temp0:HLT** should be selected by default, no need to change this.
7. For *Condition* change the default from "---" to **is >=** since we want the temperature of the strike water to be at least 155.
8. For *Value*, input your target temperature of 155.
9. For *On Exit Cond, Goto State* change your state to your next state, in this case **S1: Hold At Strike**
10. **Click apply**

The result should resemble this:

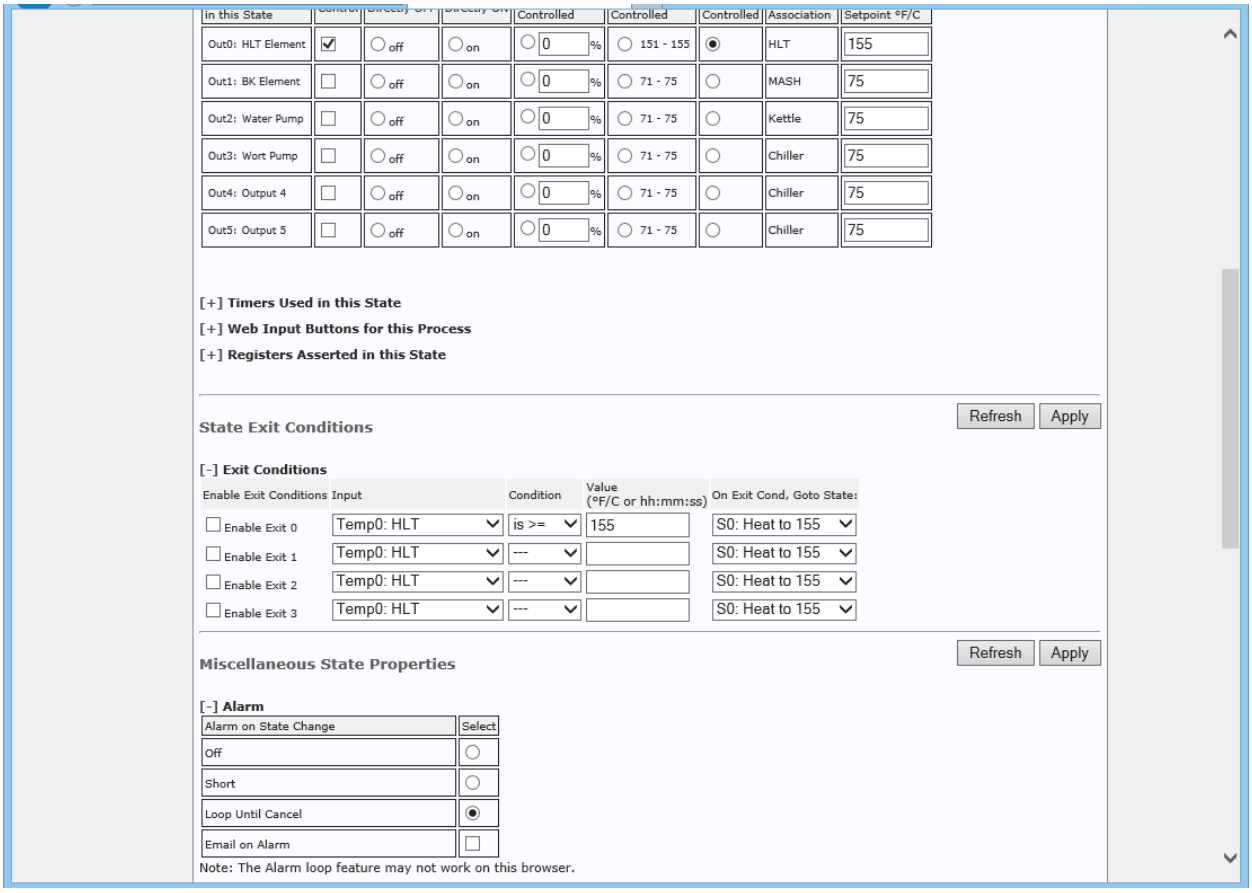


Edit Process: Current State Properties: Second State

For state **S1: Hold At Strike** your ouputs will remain the same as **S0** because you still want to maintain 155 degrees. However, we want the system to alert us that the water is to temperature so that we may add our grains.

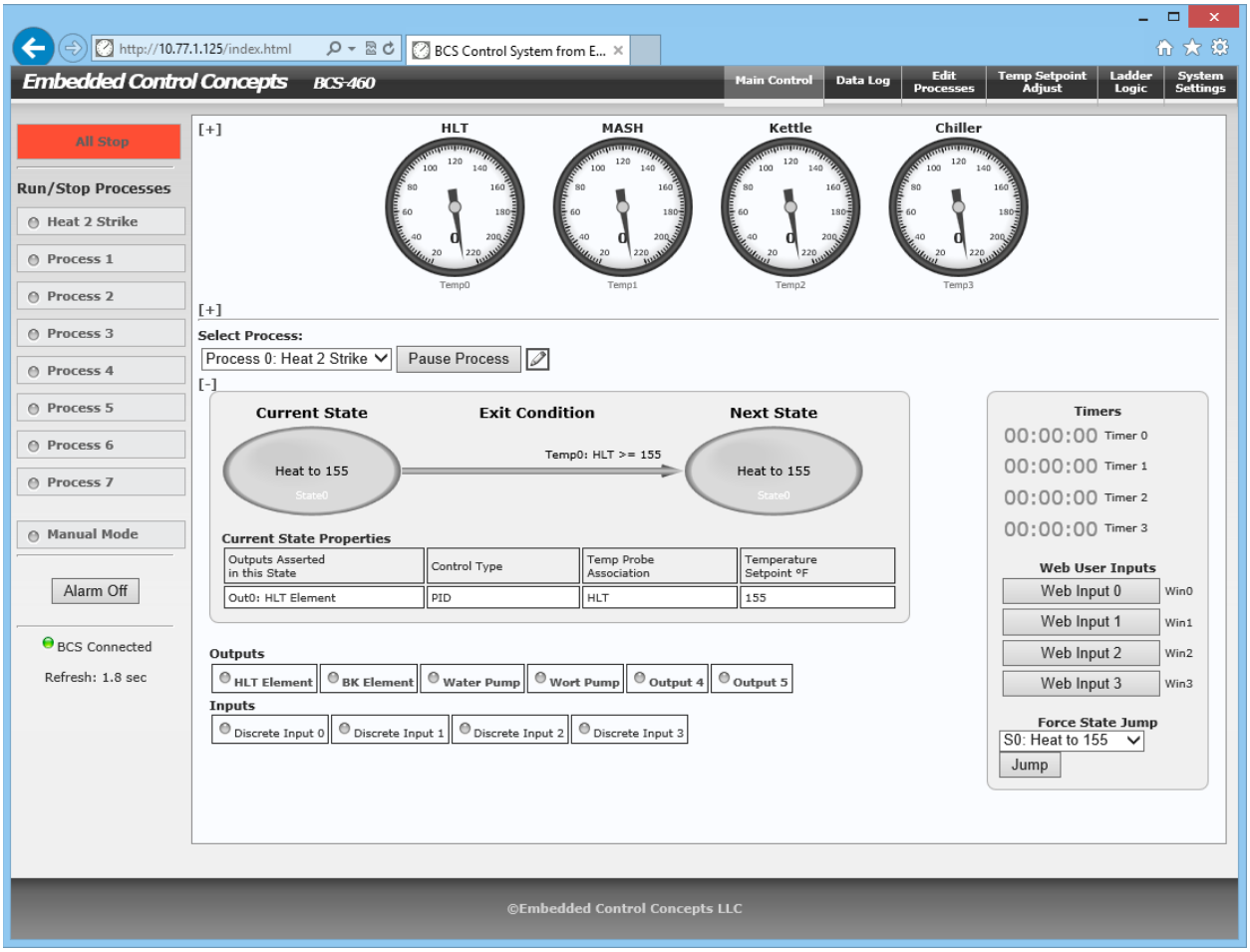
To accomplish our goals for our second state:

1. Click the square checkbox beside **Out0: HLT Element**, enabling Control
2. Click the radio (circular) button under **PID Controlled**
3. Change Temperature setpoint from default of 75 to **155**
4. Scroll down to Miscellaneous State Properties
5. Click on [+] for Alarm
6. Select the desired alarm setting. For this example, we will have it go until we hit the cancel button.
7. **Click Apply**



First Process and Setup Complete

Now that you have setup your BCS, and created your first process, when you click on Main Control you should get something that resembles this:



Simple Ramp and Soak Mash process

When it comes to brewing and cooking your Mash, the BCS can shine or it can be a challenge, ultimately it should be your best friend. With BCS you can now take on step mash programs, or single infusion, and keep it consistent from batch to batch. When writing this process though, keeping it simple should be key. While the BCS does have functionality for smarter ramps, it is easiest to show the simple method since.

Borrowing from the first process in this guide, start editing your next process, making sure it isn't your heat to strike process. Label all your states and the process and hit apply. A sample of labels could be:

- **Process:** Cook Mash
- **State 0:** Set Temp 140
- **State 1:** Hold Temp 140
- **State 2:** Set Temp 150
- **State 3:** Hold Temp 150
- **State 4:** Set Temp 160
- **State 5:** Hold Temp 160
- **State 6:** Set Temp 170
- **State 7:** Hold Temp 170

Click **Apply** to save these tags and then proceed to edit the process.

For the states, we'll keep it simple, we create the first 2, from here you can copy similar states with different temperatures in place.

For **State 0** you have already mashed in, so your interest is in insuring you hit your target mash temp to start, in order to do so, you want to be sure your HLT temperature is within a few degrees of your target in the Mash, usually 1 or 2 degrees over target, but this can differ in part based on where the Mash Probe is mounted.

During these states, be sure to enable your pump outputs in each, without the continuous pumping, the mash won't reach or maintain your target temps since no wort is moving.

To begin your mash process, in state0, set your **OUT0:HLT ELEMENT, PID,** to your target temperature +/- 2 degrees (142 for this example). Then scroll to **Exit Conditions** and set your first exit condition to **TEMP1:MASH PROBE** when **>=** your target temperature of 140. Once your mash hits this temperature it should then proceed to **State 1: Hold**. In hold, carry over your OUT0 setting of 142, but then enable **Timer0**, and leave set to counting up. In Exit Conditions, set your conditions as **Timer0 >= 20:00** for 20 minutes, subbing 20 for whatever time you desire. Then proceed to state 2 and repeat, running through each of your temperatures. If you use a single infusion, then the State 1 exit would proceed to mash out.

Mashing Out

Mashing out in BCS can be a simple state, with only pump outputs enabled. Or you can setup a 3 state process where first state maintains your HLT element on, second neither element, third turns on the Boil element. At the very least we recommend the second and third since by turning on the Boil element mid mash out, you will reduce the wait time to boil later in your process.

Boil Process

For a Boil process, the breakdown is a matter of hop additions, timers, and a new concept in our write up called duty cycle. When boiling with electric, you will find that powering the elements at a full 100% through the boil can result in boil over because, as with gas, the wort gets to vigorous. To adjust for this, rather than using direct on or PID, we use duty cycle.

A little more info about duty cycle: For Boil, some manual control may be necessary in order to reduce the chance of a boil over from too much power. As in gas, where you dial back the valve to reduce the flow, electric has a digital variant called Duty Cycle. The easiest explanation of Duty cycle is that for every 10 seconds of activity, duty cycle determines how long the element is on, and how much off, then cycles over 10 second intervals. For instance, if you select 70%, duty cycle therefore has the element on for 7 seconds of every 10. Note that for this simple explanation, I used 10 seconds, but actual practice this will be a faster window such as 3 seconds.

Within your BCS, you can create your boil process to alert you, or pause, while waiting for hop additions in your schedule, if you use our alarm output this becomes very convenient.

An example of a boil process is as follows:

- **State0:** Bring to Boil
  - **Out2:** BOIL Element ➔ PID Controlled ➔ 208 degrees
  - **Exit:** Boil Probe ➔ >= ➔ 207 degrees ➔ Goto state1
- **State1:** Boil Start
  - **Out2:** Boil Element ➔ Duty Cycle ➔ 70
  - **Out5:** Alarm ➔ Direct On
  - **Exit:** Web Input (or DIN0) ➔ Is ON ➔ Goto state2
- **State2:** Boil
  - **Out2:** Boil Element ➔ Duty Cycle ➔ 70
  - **Timer0: enabled** ➔ Count Up ➔ start at 0
  - **Exit:** Timer0 ➔ >= ➔ 45:00 (for 1 hour boil) ➔ Goto state3
- **State3:** Whirfloc & Hops Add
  - **Out2:** Boil Element ➔ Duty Cycle ➔ 70
  - **Out5:** Alarm ➔ Direct On
  - **Exit:** Web Input (or DIN0) ➔ Is ON ➔ Goto state4
- **State4:** Boil Finish
  - **Out2:** Boil Element ➔ Duty Cycle ➔ 70
  - **Timer0: enabled** ➔ Count Up ➔ start at 0
  - **Exit:** Timer0 ➔ >= ➔ 15:00 (for 1 hour boil) ➔ Goto state5

- State5: Boil Completed
  - Out5: Alarm ➔ Direct On
  - Exit: Web Input (or DIN0) ➔ Is ON ➔ Goto state6
- State6: Whirlpool/Knockout
  - Out4: Wort Pump ➔ Direct On

It's important to note, these are not the only process solutions, trial and error will play into your process development as you find what works best for your brew process. The goal was to keep it simple, as it should be, but also cover as much as we could to help you get started.

You are now set with the basics of how to setup.

For more information, refer to the BCS Wiki from Embedded Control Concepts.
A short cut to which is http://bcswiki.ebrewsupply.com

Setting up your PID panel

Setting up your Love 16C PID

Now that you have a PID control panel completely wired up and checked and test for power functionality, it is time to setup your PIDs to work for you and your brew day.

Program your sensor

Unlike the BCS that has one type of probe sensor, the PIDs are capable of supporting many. To that end, your PID is likely to have shipped supporting a different type. If you are setting up a panel that came assembled, you can skip this step. To setup your PIDs for RTD probes, first press and hold  for approximately 3 seconds. This will bring you to the 2nd tier menu. Under the second tier menu press the  until you see  then proceed to select Pt1 by pressing the up arrow until it appears. This will set your PID into RTD sensor mode.

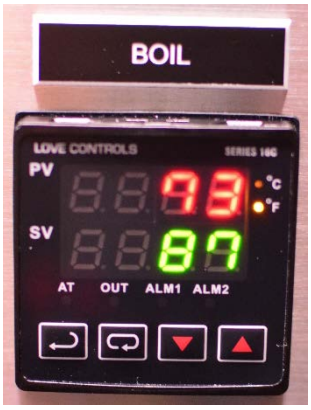
In addition to the probe sensor, you may also need to change the temp reading to reflect Fahrenheit instead of Celsius. This is done in the same menu under  which will appear as the menu option following your sensor selection. Again with the selected menu option in PV, select C for Celsius and F for Fahrenheit. Once these two settings are in place you can exit back to the main function screen and see your handy work by pressing the back arrow button  .

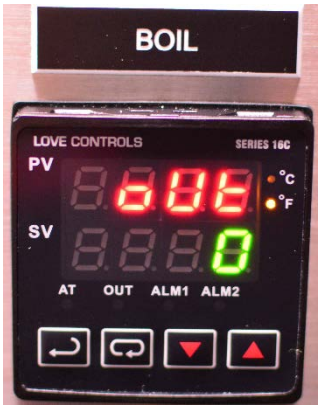
Program PID and Manual options

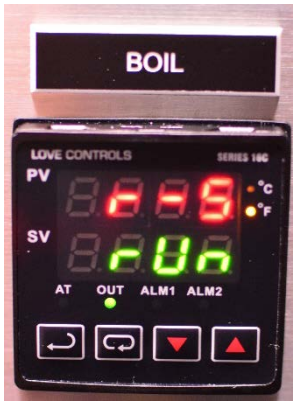
When it comes to using PID temperature controls, the temperature is your primary control, which in the case of the HLT or Mash PIDs, is all you will need. However, for Boil, manual control is necessary in order to reduce the chance of a boil over from too much power. As in gas, where you dial back the valve to reduce the flow, electric has a digital variant called Duty Cycle. The

easiest explanation of Duty cycle is that for every 10 seconds of activity, duty cycle determines how long the element is on, and how much off, then cycles over 10 second intervals. For instance, if you select 70%, duty cycle therefore has the element on for 7 seconds of every 10. Note that for this simple explanation, I used 10 seconds, but actual practice this will be a faster window such as 3 seconds.

It should be noted that manual mode will be the default setting for Boil PIDs on an assembled control panel. When you approach the Boil PID you will likely see one of 2 screens, one showing temperatures, or one showing the manual mode out setting of 0.







If you don't see out available, then press the  button until you see  and insure it is set to run instead of stop. This is a fast way to shut off your boil control on the PID if you don't want to scroll from 100 down to zero.

To configure PID temperature control versus manual control, press and hold  for approximately 3 seconds and then press  until you find  (about the 4th or 5th menu item) and select  for manual mode or  for PID temperature control.

Auto Tune

At this point, the probes should be setup. You could begin brewing but for optimal performance it is recommended you run auto tune on your HLT PID unit. You could also do this for your Boil, but it isn't necessary for the function unless you plan to have specific temperature related steps carried out in your boil. Once auto-tune is completed, you should not need to do it again, unless you upgrade or replace your vessel.

Before performing auto-tune, fill up your HLT (or boil kettle) with ample water, as if you planned to brew. Proceed to set your target temperature that you would typically use for your Mash temp such as 150. Once your HLT is within 10 degrees of the target temp, begin the auto tune function.

To accomplish Auto tuning, begin by pressing  , you should see 

and a setting of 

. If not, go back to the previous section and set your Control output PID. Once you've set SV to 

the LED below AT 

will light up. At this point you can press  and watch Auto-tune do its job.

The PID will continue heating and will even raise the temperature past your target set value, drop below it, and then raise again. This cycle will repeat until the PID recognizes how the system reacts; after which point it can set the proportional, integral, and derivative parameters automatically. The auto tuning process should take between 20-40 minutes but can vary based on the system size. Do not make any changes to the system during this time or auto tuning will not work correctly. Once auto tuning is complete the AT led will shut off SV will continue displaying the target temperature.

For more tips see the Appendix which includes the Love Control manuals for more in depth fine tuning.

Using the Love LCT216 Timer

Intended to make your life easier, the LCT216 timer is a very simple to use timer. When shipped in an assembled panel, the PID is preconfigured as a simple seconds countdown timer. To start it over, simply press the reset button. To adjust the time, use the  buttons. Simply press either up or down to initiate the change. By using the left selector, you can speed up the input by moving over a column. For example: From the 60 in the picture, press up or down and a row of zeros will precede the 6, while the 0 in 60 will be blinking. If you press and hold up, the counter will roll by 1 second at a time, upwards and a quick pace; but if you press the left arrow over one or 2 columns, you can quickly adjust 10s, 100s, 1000s of seconds. Once you have your

time set, press mode. When you're ready for the timer to begin, simply press **start** and the timer will begin counting down. If at any point you want to interrupt/restart the count, simply press **reset** and **start** again.

To configure your timer to operate in this fashion. First press **Mode** and hold for approximately 3 seconds. The timer menu will appear, starting with:

First Setting: Timer function up

Second Setting: Counting down instead of

Simply press mode to select through each menu option available. To change the menu setting, press either one of the  buttons, and the option will begin to flash quickly. Press either  button to scroll through the options. Once found press **Mode** to lock the setting in.

Third Setting: Timer function at zero seconds sound

Timer sounds alarm, and resets to initial time.

Forth Setting: How long does the alarm

Timer sounds for 30 minutes in this example

Most important setting: What unit in time do you want to use?

Reads out in seconds, 90 = 90 seconds

Reads out in Minutes, 90 seconds = 1.5 minutes

This last setting is key to reading the display. We recommend using S1 as it shows time in seconds, but you can change this to a few others options. The 2 options shown would fit best for most brewing applications.

Once you are finished in the settings menu. Press and hold Mode for approx. 3 seconds and the menu will return to the timer screen.

Products Reference

220v and 110v LED Indicators

2-Way Toggle Switch

3-Way Toggle Switch

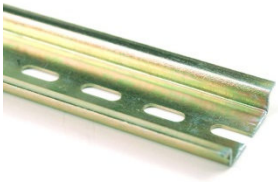
NO Contacts

All switches will have 1 or 2 “NO Contacts” on the back. These are attached via the middle, silver/brass colored screw. These can be added and removed as you go if necessary.

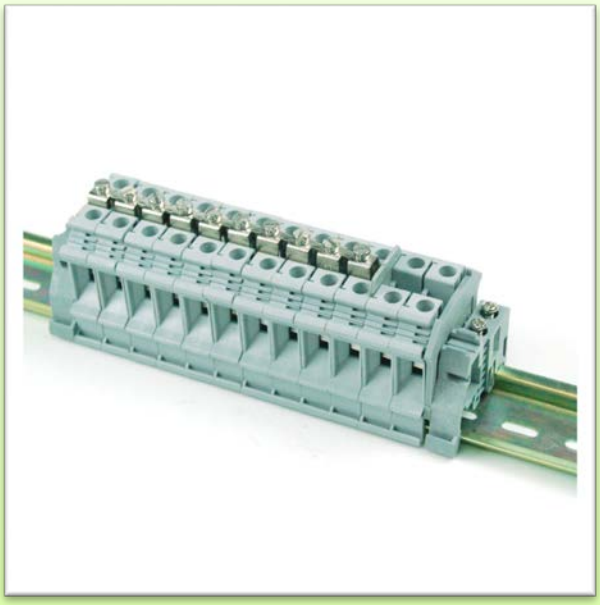
Mushroom E-Stop

Key Switch

DIN Rail



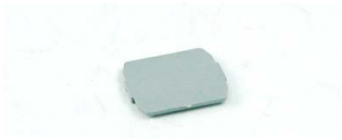
Using DIN Rail terminals



DIN Rail Terminal Block

DIN Rail Connection/Terminal Bridge

DIN Rail Separators



DIN Rail End Cover

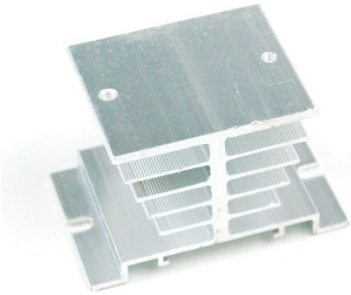
DIN Rail Anchor End

DIN Rail Contactor

Low-cost Contactor

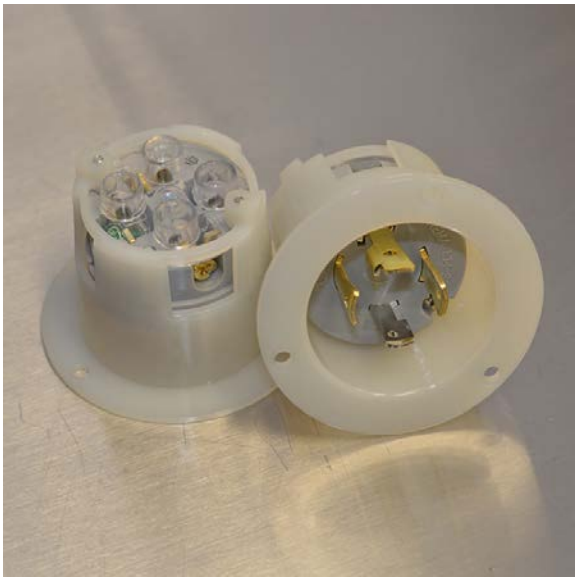
Solid State Relay

Solid State Relay Heatsink



Power Inlets and connectors

L14-30 Twist Locking Flanged Inlet



L14-30 Twist Locking Connector

CS6375 Flanged 50a Power inlet

CS6364C 50a power connector

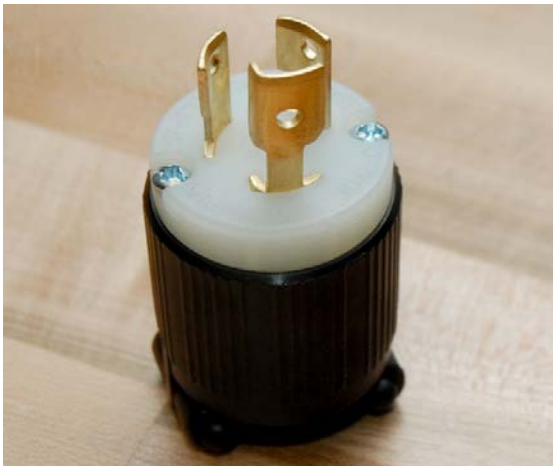
Power Outlets

L6-30 Twist Locking Flanged Outlet

L6-30 Twist Locking Plug

L5-15 Twist Locking Flanged Outlet

L5-15 Twist Locking Plug



SJOOW Cable 10/3

SJOOW Cable 10/4

Appendix: PID and Timer Manuals

Bulletin E-90-CPC

Series 4C, 8C and 16C Microprocessor Based Temperature Process Control

Specifications - Installation and Operating Instructions

LOVE CONTROLS DIVISION
DWYER INSTRUMENTS INC.
P.O. BOX 338 - MICHIGAN CITY, INDIANA 46360, U.S.A.

Phone: 219/879-8000 www.love-controls.com
Fax: 219/872-9057 e-mail:love@love-controls.com

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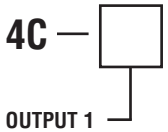
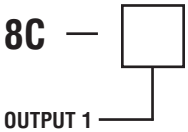
MODEL NUMBER IDENTIFICATION



2 = Voltage Pulse
3 = Relay
5 = Current
6 = Linear Voltage



2 = Voltage Pulse
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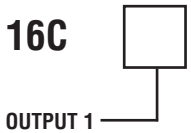


2 = Voltage Pulse
3 = Relay
5 = Current
6 = Linear Voltage

GETTING STARTED

1. Install the control as described on page 4.

2. Wire your control following the instructions on page 6. Please read the Precautions section located at the end of this manual before wiring the control.

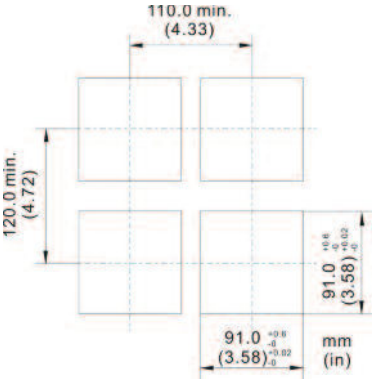
3. For best results when programming changes are necessary, make all changes to the Initial Setting mode (Pages 13-14) before making changes to the Regulation Mode (Pages 11-12) or Operation Mode (Pages 10). If any error messages occur, check the Diagnostic Error Message Section (Page 18) for assistance.

INSTALLATION

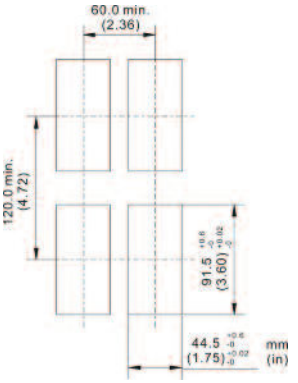
Mount the instrument in a location that will not be subject to excessive temperature, shock, or vibration. All models are designed for mounting in an enclosed panel.

Select the position desired for the instrument on the panel. Prepare the panel by cutting and deburring the required opening per the panel cut out dimensions listed below. Follow the mounting instructions listed on page 5. Lastly, wire the controller per the appropriate wiring diagram listed on page 6.

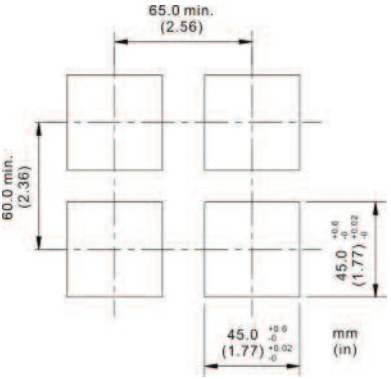
PANEL CUTOUT DIMENSIONS



4C



8C



16C

MOUNTING METHOD

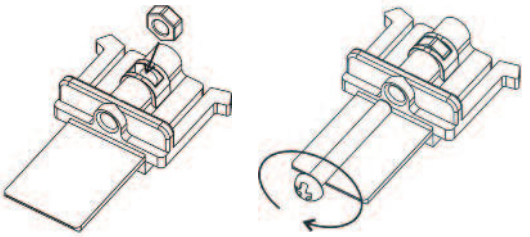
Step 1: From the front of the panel, slide the controller housing through the cut out. The housing gasket should be against the housing flange before installing.

Step 2: Insert the mounting brackets into the mounting grooves on the top and bottom of the controller (4C, 8C, and 16C).

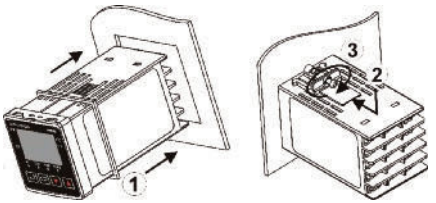
Step 3: Push the mounting brackets forward until the bracket stops at the panel wall.

Step 4: Insert and tighten the screws on the bracket to secure the controller in place. (The screw torque should be 0.8 kgf-cm).

Mounting Bracket Installation



4C/8C/16C Mounting Method



WIRING

Do not run thermocouple or other class 2 wiring in the same conduit as power leads. Use only the type of thermocouple or RTD probe for which the control has been programmed. Maintain separation between wiring of sensor, auxiliary in or out, and other wiring. See the Initial Setting Menu for input selection.

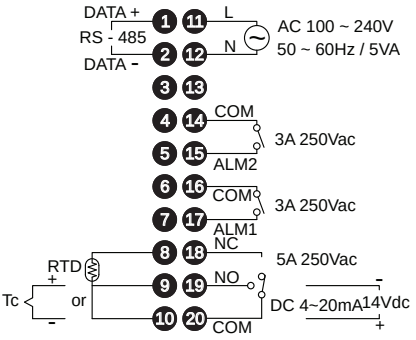
For thermocouple input always use extension leads of the same type designated for your thermocouple.

For supply connections use No. 16 AWG or larger wires rated for at least 75˚ C. Use conductors only. All line voltage output circuits must have a common disconnect and be connected to the same pole of the disconnect.

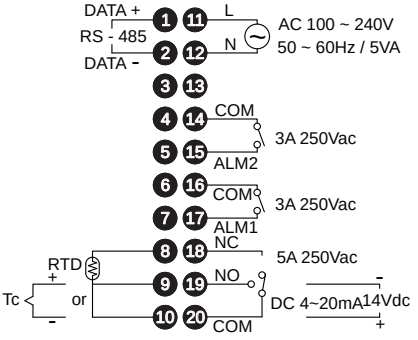
Input wiring for thermocouple, current, and RTD; and output wiring for current 14 VDC is rated CLASS 2.

Control wiring as show below:

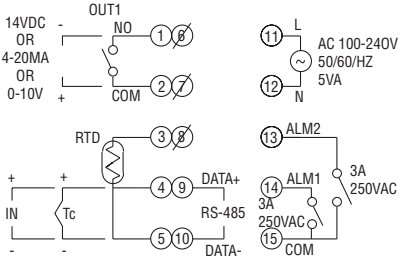
Terminal Identification



4C



8C



16C

FRONT KEY FUNCTIONS

Key functions are as follows:

INDEX: Pressing the INDEX key advances the display to the next menu item.

UP ARROW: Increments a value or changes a menu item. If pressed during the **Operation Mode**, the set point value will be increased.

DOWN ARROW: Decrements a value or changes a menu item. If pressed during the **Operation Mode**, the set point value will be decreased.

ENTER: Stores the value or item change. If not pressed, the previously stored value or item will be retained. When pressed during the **Operation Mode**, the controller switches to the **Regulation Mode**. If held for more than 3 seconds during the **Operation Mode**, the controller switches to the **Initial Setting Mode**. If pressed during the **Regulation Mode** or **Initial Setting Mode**, the controller will return to the **Operation Mode**.

SECURITY FEATURES

The C series controller has two built in security lock settings to prevent unauthorized personnel from changing parameter settings. These parameters are set in the **Operation Mode**.

The LoC1 setting affects all parameters in the controller. If LoC1 setting is enabled, the operator will have to unlock the controller to make any changes to the controller's parameters.

The LoC2 setting affects all parameters except the set point. If LoC2 setting is enabled, the only parameter that the operator will be able to change is the set point. In order to change any other parameters, the operator will have to unlock the control before making a change.

In order to unlock the control, the operator must depress the ENTER and INDEX key simultaneously.

CONTROL OPERATION DESCRIPTION

The HOME display is the normal display while the control is operating. If no errors or functions are active, the HOME display will indicate the Process Variable that is being measured on the top display and the Set Variable on the bottom display.

Error Messages are shown on page 18.

Heating or Cooling

Temperature Control can be achieved by either heating or cooling. Please refer to the following for the operation of each setting.

Control Modes are selected by changing the S-HC parameter in the Initial Setting Mode.

Select HEAt, for heating or reverse acting control for output 1.

Select CooL, for cooling or direct acting control for output 1.

PROGRAMMING AND OPERATION FOR PID

Theory of Operation

The PID method of control is based on the individual tuning of proportional band values, integral time values, and derivative time values to help a unit automatically compensate for changes in a control system. The proportional band is the range around the set point in which the control's proportioning takes place. The control increases or decreases the output proportionately to the process temperature's deviation from the set point. The integral time eliminates undershoot and overshoot of the set point by adjusting the proportioning control based on the amount of deviation from the set point during steady state operation. The derivative time eliminates undershoot and overshoot by adjusting the proportioning control based on the rate of rise or fall of the process temperature. The integral deviation offset correction (ioFn) improves the speed in which the process value reaches the set point value. If this parameter is set to zero, the output will be zero when the process value is equal to the set point value. If the integral time parameter is used only to eliminate steady state error, it may take a long time to reach the set point because it needs time to accumulate the error. This parameter defines the default output level on start up. When the integral time is set at 0, then the proportional derivative offset correction (PdoF) would replace the integral deviation offset correction, but serves the same function.

Program Set Up

In order to use the PID function in the C series controllers, the Control Mode will have to be set to PID in the Initial Setting Menu. After changing the Control Mode, the PID parameters can be accessed in the Regulation Menu. The PID parameters can either be programmed manually or they can be set by the controller using the auto tune function. The auto tune will use trial and error to tune the PID parameters to give the control the most precise control. Since the time to accurately tune the control may differ depending on the process, the controller can also be manually tuned to known PID values prior to running auto tune. The Run/Stop parameter must be set to run in order to start auto tuning.

DESCRIPTION OF MENU STRUCTURE

The programming for the controller is broken down into three menus (Operation, Regulation, and Initial Setting). Upon normal operation, control will be in the Operation Menu.

OPERATION MENU

Pressing the INDEX key will cycle through the below menu items. The parameter will be displayed in the top display, while its value will be displayed in the bottom display, except for the set point which is displayed in the bottom display on the Home Display. The UP and DOWN arrows change the values of the parameters. The ENTER key must be pressed after any changes.

1234		Adjust the set point value - Can be any numerical value between the upper and lower limit of the temperature range.
r-S		Select Run - Stop Output Control.
	rUn	Activates outputs.
	StoP	De-activates outputs.
AL 1H		Alarm 1 High Set Point. May not appear depending on ALA1 setting in Initial Setting Menu.
AL 1L		Alarm 1 Low Set Point. May not appear depending on ALA1 setting in Initial Setting Menu.
AL2H		Alarm 2 High Set Point. May not appear depending on ALA2 setting in Initial Setting Menu.
AL2L		Alarm 2 Low Set Point. May not appear depending on ALA2 setting in Initial Setting Menu.
LoC		Set front panel security lock.
	LOC 1	Lock all settings.
	LOC2	Lock all settings except the set point.
oUt 1		Display the % output value for output 1. In manual mode, this value can be changed using the up and down arrows.

REGULATION MENU

Press the ENTER key while at the Home Display in order to access the Regulation Menu. Pressing the INDEX key will cycle through the below menu items. The parameter will be displayed in the top display, while its value will be displayed in the bottom display. The UP and DOWN arrows change the values of the parameters. The ENTER key must be pressed after any changes.

AT		Auto Tune. The controller will evaluate the process and select the PID values to maintain good control. Only available when the control mode is set to PID.
	on	Start learning the process. After the process has been earned the menu will revert to oFF.
	oFF	Disables Auto Tune.
	P	Proportional Band Setting.
	I	Integral time (reset time).
	d	Derivative time (rate time).
PdoF		PD Offset Correction Setting. only available when control mode is set to PID and integral time = 0. See Programming and Operation of PID function for moving information.
IoFn		Integral Deviation Offset Correction associated with each PID Profile. (n = 0 to 4).
HtS		Heating Hysteresis (Differential) Setting. Sets the value for the amount of difference between the turn off point (set point) and the turn on point. Figure A shows the output behavior for a heating (reverse acting) application. Only available when control mode set to on/off control.
CtS		Cooling Hysteresis (Differential) Setting. Sets the value for the amount of difference between the turn off point (set point) and the turn on point. Figure A shows the output behavior for a cooling (direct acting) application. Only available when control mode set to on/off control.

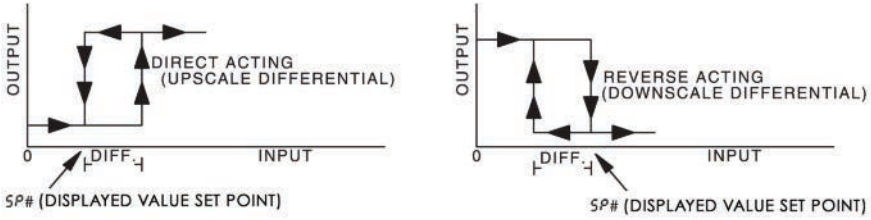


Figure A: Output behavior for Heating/Cooling On/Off Applications

HtPd	Heating Control Cycle Setting. Defines the duration for one output period or cycle for output 1. Only available when control mode is set to PID and Output 1 is set for heating.
CLPd	Cooling Control Cycle Setting. Defines the duration for one output period or cycle for output 1. Only available when control mode is set to PID and Output 1 is set for cooling.
tPoF	Process Temperature Offset. This feature allows the input value to be changed to agree with an external reference or to compensate for sensor error.
CrH	Analog Output High Limit: Sets the actual upper limit of the analog output when the control's output is operating at 100%. Only available for analog output models.
CrLo	Analog Output Low Limit. Sets the actual lower limit of the analog output when the control's output is operating at 0%. Only available for analog output models.

INITIAL SETTING MENU

Press and hold the ENTER key for at least 3 seconds while at the Home Display in order to access the Initial Setting Menu. Pressing the INDEX key will cycle through the below menu items. The parameter will be displayed in the top display, while its value will be displayed in the bottom display. The UP and DOWN arrows change the values of the parameters. The ENTER key must be pressed after any changes.

inPt Input Selection. Select one of the following input types from the below table.

Input Temperature Sensor Type	LED Display	Temperature Range
Thermocouple TXK type	tXK	-328 ~ 1440°F (-200 ~ 800°C)
Thermocouple U type	U	-328 ~ 932°F (-200 ~ 500°C)
Thermocouple L type	L	-328 ~ 1562°F (-200 ~ 850°C)
Thermocouple B type	b	212 ~ 3272°F (100 ~ 1800°C)
Thermocouple S type	S	32 ~ 3092°F (0 ~ 1700°C)
Thermocouple R type	r	32 ~ 3092°F (0 ~ 1700°C)
Thermocouple N type	n	-328 ~ 2340°F (-200 ~ 1300°C)
Thermocouple E type	E	32 ~ 1112°F (0 ~ 600°C)
Thermocouple T type2	t2	-4 ~ 752°F (-20 ~ 400°C)
Thermocouple T type1	t1	-328 ~ 752°F (-200 ~ 400°C)
Thermocouple J type2	J2	-4 ~ 752°F (-20 ~ 400°C)
Thermocouple J type1	J1	-148 ~ 1562°F (-100 ~ 850°C)
Thermocouple K type2	K2	-4 ~ 932°F (-20 ~ 500°C)
Thermocouple K type1	K1	-328 ~ 2340°F (-200 ~ 1300°C)
Platinum Resistance (Pt100) type 3	Pt3	32 ~ 212°F (0 ~ 100°C)
Platinum Resistance (Pt100) type 2	Pt2	-4 ~ 932°F (-20 ~ 500°C)
Platinum Resistance (Pt100) type 1	Pt1	-328 ~ 1112°F (-200 ~ 600°C)
Platinum Resistance (JPt100) type 2	JPt2	32 ~ 212°F (0 ~ 100°C)
Platinum Resistance (JPt100) type 1	JPt1	4 ~ 752°F (-20 ~ 400°C)

tPUn Temperature Units. This parameter is only available for thermocouple or RTD inputs.

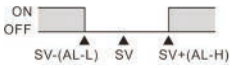
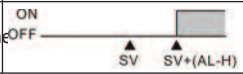
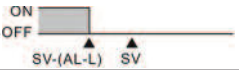
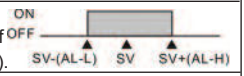
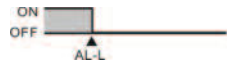
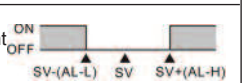
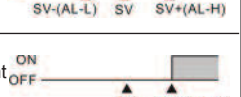
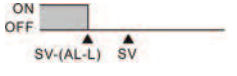
tP-H Scale Height Limit. Sets the upper limit of the temperature range. If the process temperature exceeds this setting, the display will flash an error code.

tP-L Scale Low Limit. Sets the lower limit of the temperature range. If the process temperature exceeds this setting, the display will flash an error code.

CtrL Control Mode. Select method of control operation. Can be set to PID, On-Off, or Manual.

S-HC	Heat/Cool Selection. Assigns output 1 to be either heat or cool. HEAt = Output 1 = Heating CooL = Output 1 = Cooling
AL1	Alarm 1 Setting. Sets operation for Alarm 1. Please see selection on Alarm Outputs for description of the outputs.
AL2	Alarm 2 Setting. Sets operation for Alarm 2. Please see selection on Alarm Outputs for description of the outputs.
CoSH	Communications Write Function Feature. Allows parameters to be changed via the RS-485 communications. Setting to oFF prevents any changes from remote users.
C-no	Controller Address: Set from 1 to 247. This value must match the controller address used by the host computer.
bPS	Baud Rate Setting. This value must match the communication baud rate of the host computer.
LEn	Communication Data Length. Choose either 7 or 8. This value must match the communication data length of the host computer.
PrtY	Communication Parity Bit. Set this value to even, odd, or none. This value must match the communication parity bit of the host computer.
StoP	Communication Stop Bit. Set this value to 1 or 2. This value must match the communication stop bit of the host computer.

Alarm Output Configuration and Operation Table.

Set Value	Alarm Type	Alarm Output Operation
0	Alarm function disabled	Output is OFF
1	Deviation upper- and lower-limit: This alarm output operates when PV value is higher than the setting value SV+(AL-H) or lower than the setting value SV-(AL-L).	
2	Deviation upper-limit: This alarm output operates when PV value is higher than the setting value SV+(AL-H).	
3	Deviation lower-limit: This alarm output operates when PV value is lower than the setting value SV-(AL-L).	
4	Reverse deviation upper- and lower-limit: This alarm output operates when PV value is in the range of the setting value SV+(AL-H) and the setting value SV-(AL-L).	
5	Absolute value upper- and lower-limit: This alarm output operates when PV value is higher than the setting value AL-H or lower than the setting value AL-L.	
6	Absolute value upper-limit: This alarm output operates when PV value is higher than the setting value AL-H.	
7	Absolute value lower-limit: This alarm output operates when PV value is lower than the setting value AL-L.	
8	Deviation upper- and lower-limit with standby sequence: This alarm output operates when PV value reaches set point (SV value)and the value is higher than the setting value SV+(AL-H) or lower than the setting value SV-(AL-L).	
9	Deviation upper-limit with standby sequence: This alarm output operates when PV value reaches set point (SV value) and the reached value is higher than the setting value SV+(AL-H).	
10	Deviation lower-limit with standby sequence: This alarm output operates when PV value reaches the set point (SV value) and the reached value is lower than the setting value SV-(AL-L).	
11	Hysteresis upper-limit alarm output: This alarm output operates if PV value is higher than the setting value SV+(AL-H). This alarm output is OFF when PV value is lower than the setting value SV+(AL-L).	
12	Hysteresis lower-limit alarm output: This alarm output operates if PV value is lower than the setting value SV-(AL-H). This alarm output is OFF when PV value is higher than the setting value SV-(AL-L).	

(Note: AL-H and AL-L include AL1H, AL2H, AL3H and AL1L, AL2L, AL3L)

Communication Register List

Communication Parameters List

Controller offers a RS-485 port for serial communication.

1. Supporting transmission speed: 2400, 4800, 9600, 19200, 38400 bps.
2. Communication protocol: Modbus (ASCII).
3. Non-supported formats: 7, N, 1 or 8, O, 2 or 8, E, 2.
4. Available communication address: 1 to 255, 0 is broadcast address.
5. Function code: 03H to read the contents of register (Max. 3 words).
6. 06H to write 1 (one) word into register.

Address	Content	Explanation
4700H (R)	Process value (PV)	Measuring unit is 0.1, updated one time in 0.5 second.
4701H	Set point (SV)	Unit is 0.1, oC or oF
4702H	Upper-limit alarm 1	
4703H	Lower-limit alarm 1	
4704H	Upper-limit alarm 2	
4705H	Lower-limit alarm 2	
4706H	Upper-limit of temperature range	The data content should not be higher than the temperature range
4707H	Lower-limit of temperature range	The data content should not be lower than the temperature range
4708H	PB Proportional band	0.1 to 999.9, unit is 0.1
4709H	Ti Integral time	0 to 9999
470AH	Td Derivative time	0 to 9999
470BH	Heating/Cooling hysteresis	0 to 9999
470CH ~ 470FH		Reserved
4710H	Input temperature sensor type	Please refer to the contents of the “Temperature Sensor Type and Temperature Range” for detail
4711H	Control method	0: PID (default), 1: ON/OFF, 2: manual tuning
4712H	Heating/Cooling control cycle	1 to 99 second
4713H	Proportional control offset error value	0% to 100%
4714H	Temperature regulation value	-999 ~ 999, unit: 0.1
4715H	Alarm 1 type	Please refer to the contents of the “Alarm Outputs” for detail
4716H	Alarm 2 type	Please refer to the contents of the “Alarm Outputs” for detail
4717H	Temperature unit display selection	oC: 1 (default), oF: 0
4718H	Heating/Cooling control Selection	Heating: 0 (default), Cooling: 1
4719H	Control Run/Stop setting	Run: 1 (default), Stop: 0
471AH	Communication write-in selection	Communication write in disabled: 0 (default), Communication write in enabled: 1
471BH	Software version	W1.00 indicates 0 x 100
4729H	AT Setting	OFF: 0 (default), ON:1
472BH (R)	Code 0	Normal operation (No error)
	Code 1	Initial process
	Code 2	Initial status (Temperature is not stable)
	Code 3	Temperature sensor is not connected
	Code 4	Temperature sensor input error
	Code 5	Measured temperature value exceeds the temperature range
	Code 6	No Int. error
	Code 7	EEPROM Error
4733H	CT monitor value	Unit is 0.1A

Note: R means “read only” value

Communication Protocol

Command code to read N words: 03H. The maximum value of N is 3. For example, in order to read two words from controller 01 (address 01H) at starting data address 4700H, the command in ASCII mode is:

ASCII mode:

Command message:

STX	':'
ADR1	'0'
ADR0	'1'
CMD1	'0'
CMD0	'3'
Starting data address	'4'
	'7'
	'0'
	'0'
Number of data (count by word)	'0'
	'0'
	'0'
	'2'
LRC CHK 1	'B'
LRC CHK 0	'3'
END 1	CR
END 0	LF

Response message:

STX	':'
ADR1	'0'
ADR0	'1'
CMD1	'0'
CMD0	'3'
Number of data (count by byte)	'0'
	'4'
Content of start address 4700H	'0'
	'1'
	'9'
	'0'
Content of start address 4700H	'0'
	'0'
	'0'
	'0'
LRC CHK 1	'6'
LRC CHK 0	'7'
END 1	CR
END 0	LF

LRC check:

LRC check is the added sum from "Address" to Data content". For example, 01H + 03H + 47H + 00H + 00H + 02H = 4DH, then take the complementary of 2, B3H.

Command code to write 1 word: 06H

For example, in order to write 1000 (03E8H) in controller 01 (comm. address 01H) at starting data address 4701H, the command is ASCII mode is:

ASCII mode:

Command message:

STX	':'
ADR1	'0'
ADR0	'1'
CMD1	'0'
CMD0	'6'
Starting data address	'4'
	'7'
	'0'
	'1'
Data Content	'0'
	'3'
	'E'
	'8'
LRC CHK 1	'C'
LRC CHK 0	'6'
END 1	CR
END 0	LF

Response message:

STX	':'
ADR1	'0'
ADR0	'1'
CMD1	'0'
CMD0	'6'
Starting data addresses	'4'
	'7'
	'0'
	'1'
Data Content	'0'
	'3'
	'E'
	'8'
LRC CHK 1	'C'
LRC CHK 0	'6
END 1	CR
END 0	LF

DIAGNOSTIC ERROR MESSAGES

Display Error Messages

Display		Description	Action Required
PV	b150	Display on Start Up	No Action Required
SV	rr		
PV	No	No Input Probe Connection	Verify that sensor is wired to proper terminals. Next, check that the controller is programmed for the correct input type. Most commonly seen when controller is programmed for a RTD, while a thermocouple is connected.
SV	Cont		
PV	Err	Input Error	Verify that the input is wired to the proper terminals. Next check to see if the input type is set to the proper value. Most commonly seen when controller is programmed for a 4 to 20 mA input and 0 to 20 mA signal is wired to the controller.
SV	inPt		
PV	2001	Process Value Flashes when outside of range	Input signals may normally go above or below range limits. If not check input and correct the process temperature or increase temperature range limits using tP-H and tP-L.
SV	0.0		
PV	Err	Error EEPROM	Attempt to reset the factory default settings using the instructions in the next section. If still has error, call customer service for a return goods authorization number to have the controller evaluated at the factory.
SV	Pron		

Communication Error Messages

Error Status 102EH/4750H	**PV read back 1000H/4700H**	**Error Status**
0001H	N/A	PV Unstable
0002H	8002H	Re-initialize, no temperature at this time
0003H	8003H	Input sensor did not connect
0004H	8004H	Input Signal Error
0005H	N/A	Over Input Range
0006H	8006H	ADC fail
0007H	N/A	EEPROM read/write error

Reset Factory Default Settings

Note: Resetting Factory Default Settings erases all of the values entered by the user. Record any necessary settings before proceeding.

Warning: Erasing the user entered values may result in a safety hazard and system malfunction.

The following instructions will reset the controller to the original factory default settings.

Step 1. Press the INDEX KEY while at the Home Display until the controller reads LoC in the process display. Use the UP arrow to select LoC1. Press the ENTER KEY to save this value.

Step 2. Press and hold the UP and DOWN arrows simultaneously for one second. Upon releasing the buttons, the display will read SHou in the PV display and oFF in the SV display.

Step 3. Press the INDEX key once and the controller will read PASS in the PV display and a 4321 in the SV display. Adjust the value in the SV display to 1357 using the UP and DOWN arrows. Press the ENTER KEY to save the value.

Step 4. Cycle the power on the controller. Upon power up, all of the user set values have been erased.

SPECIFICATIONS

Input Voltage	100 to 240VAC 50/60Hz.
Operation Voltage Range	85% to 110% of rated voltage.
Power Consumption	5VA max.
Memory Protection	EEPROM 4K bit (non-volatile memory (number of writes: 100,000).
Display Method	2 line x 4 character 7-segment LED display. Process value (PV): Red color, Set point (SV): Green color.
Sensor Type	Thermocouple: K, J, T, E, N, R, S, B, L, U, TXK.
	3-wire Platinum RTD: Pt100, JPt100.
Control Mode	PID, ON/OFF, or Manual.
Control Output	Relay output: SPDT (SPST: 1/16 DIN). Max.600. Voltage pulse output: DC 14V, Max. output current 40mA.
	Current output: DC 4 ~ 20mA output
	(Load resistance: Max. 600Ω).
Display Accuracy	0.1% of measuring range.
Sampling Range	Thermocouple or Platinum RTD: 500 msec/per scan.
RS-485 Communication	MODBUS ASCII communication protocol
Vibration Resistance	10 to 55 Hz, 10 m/s^2 for 10 min, each in X, Y and Z direction.
Shock Resistance	Max. 300 m/s2, 3 times in each 3 axes, 6 directions
Ambient Temperature	32°F to 122°F (0°C to + 50°C)
Storage Temperature	-4°F to 150°F (-20°C + 65°C)
Altitude	2000 m or less
Relative Humidity	0% to 80% (non-condensing)

Thermocouple Type and Temperature Range		
Input Temperature Sensor Type	**LED Display**	**Temperature Range**
Thermocouple TXK type	tXK	-328 ~ 1440°F (-200 ~ 800°C)
Thermocouple U type	U	-328 ~ 932°F (-200 ~ 500°C)
Thermocouple L type	L	-328 ~ 1562°F (-200 ~ 850°C)
Thermocouple B type	b	212 ~ 3272°F (100 ~ 1800°C)
Thermocouple S type	S	32 ~ 3092°F (0 ~ 1700°C)
Thermocouple R type	r	32 ~ 3092°F (0 ~ 1700°C)
Thermocouple N type	n	-328 ~ 2340°F (-200 ~ 1300°C)
Thermocouple E type	E	32 ~ 1112°F (0 ~ 600°C)
Thermocouple T type2	t2	-4 ~ 752°F (-20 ~ 400°C)
Thermocouple T type1	t1	-328 ~ 752°F (-200 ~ 400°C)
Thermocouple J type2	J2	-4 ~ 752°F (-20 ~ 400°C)
Thermocouple J type1	J1	-148 ~ 1562°F (-100 ~ 850°C)
Thermocouple K type2	K2	-4 ~ 932°F (-20 ~ 500°C)
Thermocouple K type1	K1	-328 ~ 2340°F (-200 ~ 1300°C)
RTD Type and Temperature Range		
Input Temperature Sensor Type	**LED Display**	**Temperature Range**
Platinum Resistance (Pt100) type 3	Pt3	32 ~ 212°F (0 ~ 100°C)
Platinum Resistance (Pt100) type 2	Pt2	-4 ~ 932°F (-20 ~ 500°C)
Platinum Resistance (Pt100) type 1	Pt1	-328 ~ 1112°F (-200 ~ 600°C)
Platinum Resistance (JPt100) type 2	JPt2	32 ~ 212°F (0 ~ 100°C)
Platinum Resistance (JPt100) type 1	JPt1	-4 ~ 752°F (-20 ~ 400°C)

PRECAUTIONS

DANGER! Caution! Electric Shock!

1. Do not touch the AC terminals while the power is supplied to the controller to prevent an electric shock.
2. Make sure power is disconnected while checking the unit inside.
3. The symbol ⧈ indicates that this Controller is protected throughout by DOUBLE INSULATION or REINFORCED INSULATION (equivalent to Class II of IEC 536).

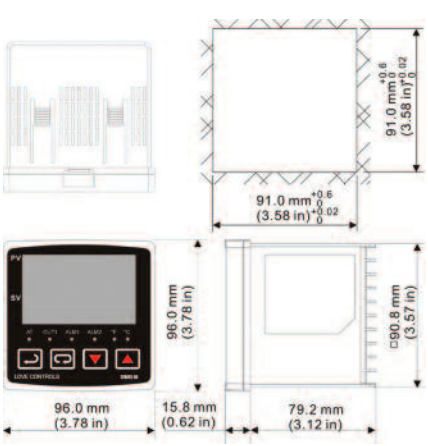
WARNING!

Mount the controller in a location that will not be subject to excessive temperature, shock, or vibration. All models are designed for mounting in an enclosed panel.

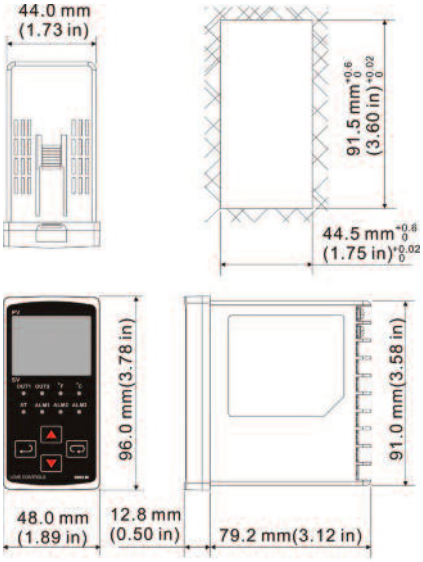
1. Always use recommended solder-less terminals: Fork terminals with isolation (M3 screw, width is 7.0mm (6.0mm for 32B Series), hole diameter 3.2mm).
   Screw size: M3 x 6.5 (With 6.8 x 6.8 square washer). Screw size for 32B Series: M3 x 4.5 (With 6.0 x 6.0 square washer). Recommended tightening torque: 0.4 N.m (4kgf.cm). Applicable wire: Solid/twisted wire of 2 mm^2, 12AWG to 24AWG. Please be sure to tighten them properly.
2. Do not allow dust or foreign objects to fall inside the controller to prevent it from malfunctioning.
3. Never modify or disassemble the controller.
4. Do not connect anything to the “No used” terminals.
5. Make sure all wires are connected to the correct polarity of terminals.
6. Do not install and/or use the controller in places subject to: Dust or corrosive gases and liquid, high humidity and high radiation, vibration and shock, high voltage and high frequency.
7. Power must be off when wiring and changing a temperature sensor.
8. Be sure to use compensating wires that match the thermocouple types when extending or connecting the thermocouple wires.
9. Please use wires with resistance when extending or connecting a platinum resistance sensor (RTD).
10. Please keep the wire as short as possible when wiring a platinum resistance sensor (RTD) to the controller and please route power wires as far as possible from load wires to prevent interference and induce noise.
11. This controller is an open-type unit and must be placed in an enclosure away from high temperature, humidity, dripping water, corrosive materials, airborne dust and electric shock or vibration.
12. Please make sure power cables and signals from instruments are all installed properly before energizing the controller, otherwise serious damage may occur.
13. Please do not use acid or alkaline liquids for cleaning. Please use a soft, dry cloth to clean the controller.
14. Wait at least one minute after power is disconnected to allow capacitors to discharge, and please do not touch any internal circuit within this period.
15. This instrument is not furnished with a power switch or fuse. Therefore, if a fuse or power switch is required, install the protection close to the instrument. Recommended fuse rating: Rated voltage 250 V, Rated current 1 A. Fuse type: Time-lag fuse.
16. Note: This controller does not provide overcurrent protection. Use of the product requires that suitable overcurrent protection device(s) must be added to ensure compliance with all relevant electrical standards and codes. (Rated 250 V, 15 Amps max). A suitable disconnecting device should be provided near the controller in the end-use installation.

External Dimensions

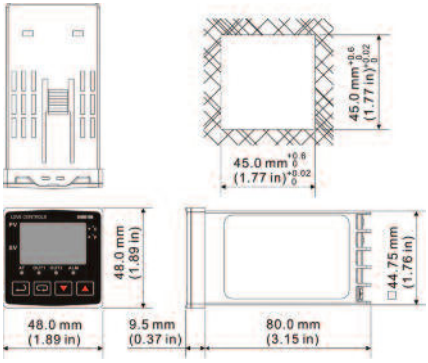
Dimensions are in millimeter (inch)



4C



8C



16C

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LOVE CONTROLS DIVISION
DWYER INSTRUMENTS INC.
P.O. BOX 338 - MICHIGAN CITY, INDIANA 46360, U.S.A.

Phone: 219/879-8000 www.love-controls.com
Fax: 219/872-9057 e-mail:love@love-controls.com

FT Series Temperature Controller

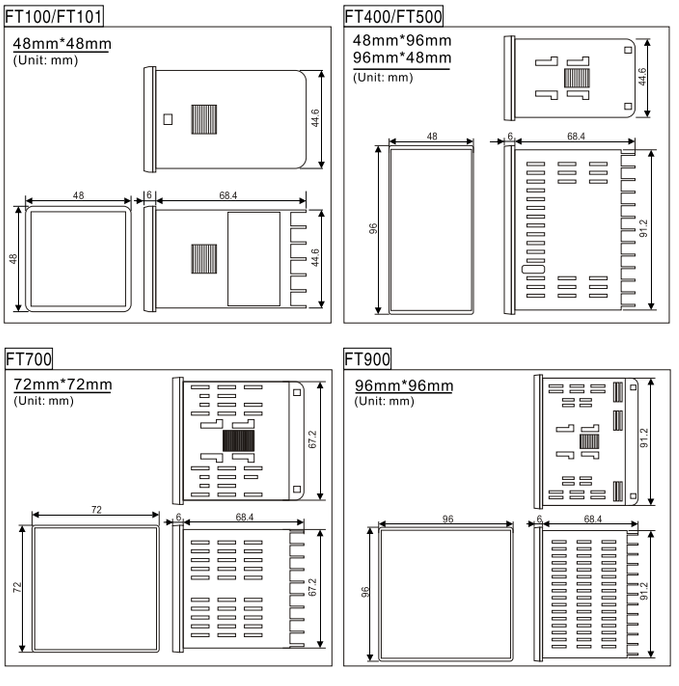
Instruction Manual

Please read this manual carefully before operating and keep it in a safe place for future reference

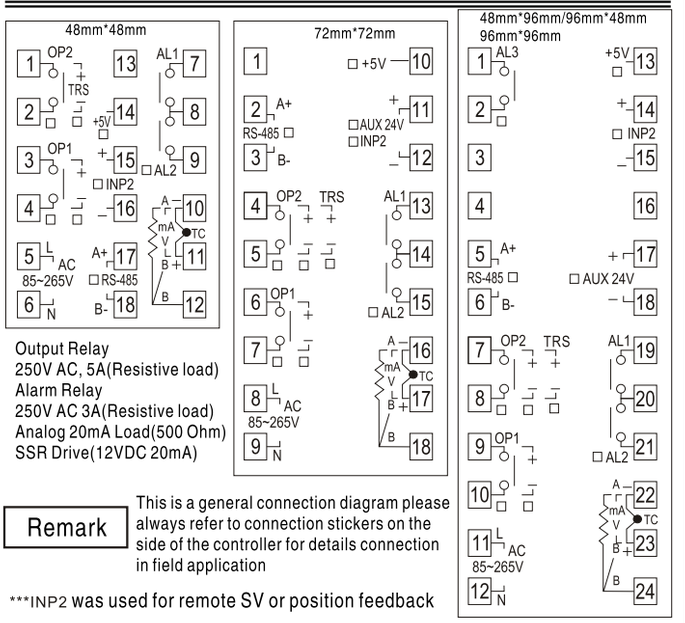
Quick Guide

- This controller is 4 digits dual display,0.2% measuring accuracy with bar graphic display, 0.1 maximum resolution for TC, RTD inputs, 0.001 maximum resolution for analog inputs such as 4-20mA,Auto/manual bumpless transfer, position feedback and RS-485, Remote SV, Heating+cooling dual output optional.
- Please make sure the correct output has been selected for your application and power cords has been connected to correct terminals before operating the units always check the diagram stickers on the side of the controller before wiring the controller
- This device supports universal inputs and be able to switch between different thermocouple and RTD sensor via front panel key,Make sure the input sensor code matches the sensors used in the field,Analog input signal has to be specified before order. check (**5.3 Parameter level 3 INP1).**
- Auto/Manual bumpless transfer features available, check (**6 Auto/manual bumpless transfer).**
- Op1 was configured as reverse control mode for heating,OP2 configured as direct action for cooling. OP1 can be set as direct for cooling as well. Check (**5.3 Parameter level 3 OUd).**
- Two group of separate PID for heating and cooling available on request, Check (**9 Dual output heating and cooling control).**
- INP2 is the input terminals for Analog remote SV or position feedback check (**8 Various control mode).**
- ON/OFF Control: When P=0, control mode switch to ON/OFF control, HYS is the hysteresis. OP1 stop when PV>SV in heating process,OP1 activated when PV<SV+HYS, output terminated when PV<SV, Output activated when PV>SV+HYS, this applies to both OP1 and OP2 for cooling
  Check(**5.2 Parameter level 2 "P" and 8 Control mode**) for more details
- Time proportional control: Set I=0, d=0, P at any value except 0 to time proportional control,Reset Windup as rSt and control cycle time as Cyt, Output gets smaller when rSt gets smaller in heating process,Output gets bigger when rSt gets smaller in cooling application. and this applies to both Op1 and Op2 refer to (**8 various control mode and 9 dual output heating and cooling**)
- Please always perform auto-tuning to get better control results in PID mode, Check (**7 Auto-tuning).**
- Please active the soft-start function to have a better control result for analog output in some specific application , Check (**5.2 parameter bUFF)**

1.Dimensions



2.Wiring Diagram

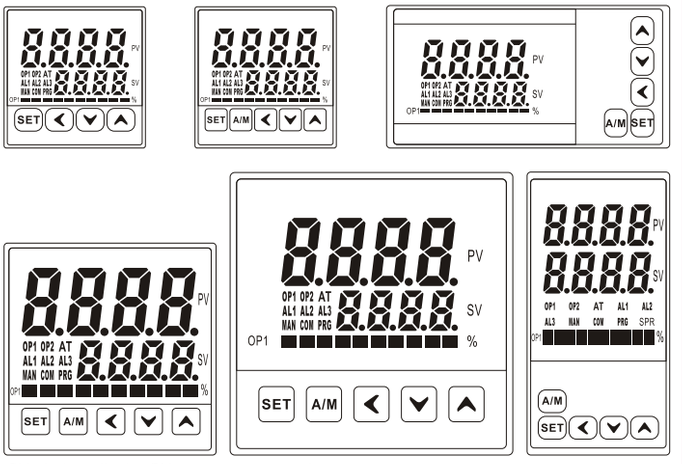


Output Relay
250V AC, 5A(Resistive load)
Alarm Relay
250V AC 3A(Resistive load)
Analog 20mA Load(500 Ohm)
SSR Drive(12VDC 20mA)

Remark This is a general connection diagram please always refer to connection stickers on the side of the controller for details connection in field application

***INP2 was used for remote SV or position feedback

3.Panel Description



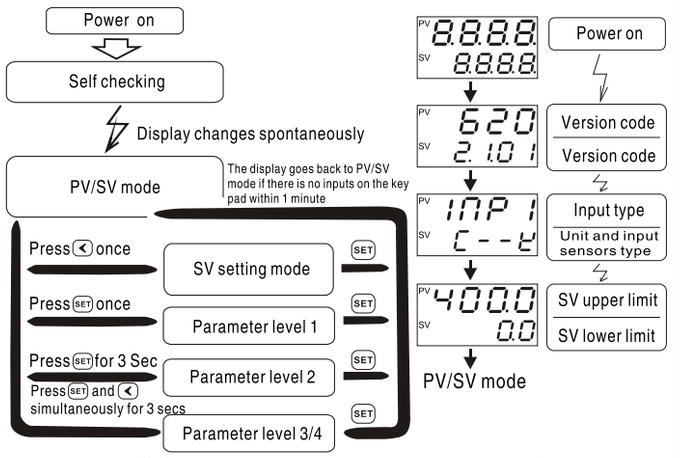
PV window, display PV or parameter notation
SV window, display SV or parameter value
Bar graphic, shows the output % or position feedback value 0-100%

SET : Function key
A/M : Auto/Manual transfer key and enter key
◀ : Shift key
▼ : Decrement key
▲ : Increment key

OP1 : Output 1 indicator
OP2 : Output 2 indicator
AT : Auto-tuning indicator
AL1 : Alarm 1 indicator
AL2 : Alarm 2 indicator
AL3 : Alarm 3 indicator
MAN : Manual control indicator
COM : Communication indicator
PRG : Reserved indicator
SPR : Reserved indicator

4.Setting

4.1 Basic setting flow charts



** Goes to parameter level 3 or 4 depends on different LCK value

Notation	E1	E2	E1	E2	J1	J2	n	U
Input type	K	K	E	E	J	J	N	Wu3_Re25
Range	400.0 ℃	1300 ℃	300.0 ℃	600 ℃	400.0 ℃	800 ℃	1300 ℃	2000 ℃

Notation	S	t	r	b	An4	An3	An2	An1	Pt1	Pt2
Input type	S	T	R	B	2-10VDC 1-5VDC 4-20mA	0-10VDC 0-5VDC 0-20mA	0-50mV	0-20mV	Pt100	Pt100
Range	1600 ℃	400.0 ℃	1700 ℃	1800 ℃					-199.9~200.0 ℃	-200~800 ℃

4.2 Change Setting Value

For example, Change SV from 0 to 200 Celcius

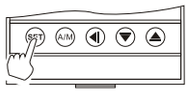
PV/SV Mode	SV setting mode	Change the SV Value	Save The Settings
PV 30 SV 0000	PV 0030 SV 0000	PV 0030 SV 0200	PV 0030 SV 200
Press ◀ key once, the unit digits at SV display flashing.	Press ◀ key to shift to hundreds digits and hundreds digits flashing	Press ▲ key to change the hundreds digits from 0 to 2 and value changes to 200	Press SET to save the configuration and display goes back to PV/SV

Remarks
The digits will increase by 1 or decrease by 1 if you press up or down key once
Digits will increase or decrease by several numbers at once if you press up or down key and do not release it, You can press A/M key once to save the configuration

5.Parameter Level

5.1 Parameter Level 1

5.1.1 Access to Parameter Level 1



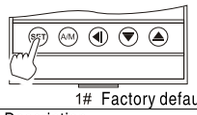
Press SET key once(Refer to image at right) to access parameter level 1
Below parameter notation will display one by one by pressing SET key, Press SET key for 3 seconds to save the changes and exit to PV/SV mode after all settings complete

1# Factory default

Notation	Name	Range	1#	Description
AT	Auto-tuning AT	NO or YES	NO	AT=YES, AT ON, AT=NO, AT OFF
AL1	Alarm 1 value	-1999 to 9999	10	Alarm Value for AL1, HYS of AL1=AH1
AL2	Alarm 2 value	-1999 to 9999	10	Alarm Value for AL2, HYS of AL2=AH2
AL3	Alarm 3 value	-1999 to 9999	10	Alarm Value for AL3, HYS of AL3=AH3
UAd	Device address		1	Check the controller's address in the communication cases

5.2 Parameter Level 2

Press SET key for at least 3 seconds to access to parameter level 2 below parameter notations will display one by one by pressing SET key



1# Factory default

Notation	Name	Range	1#	Description
P1	P1 for output 1	0.0~200.0	20.0	Proportional band for output 1, Control mode switch to ON/OFF mode when P1=0.0 .Set P=2.0 for analog signals
i1	I1 for output 1	0-3600sec	210	Integral time for OUTPUT 1, Integral action off when i1=0,the smaller the i1value is, the stronger integral action will be for the system, but system will be less stable
d1	d1 for output 1	0-3600 Sec	30	Derivative time for OUTPUT 1, derivative action off when d1=0 the greater the d1 value is, the stronger derivative action will be for the system, but system will be less stable
OLAP	Heating/cooling overlapping area	0.0-10.0	1.0	Overlapping area for heating and cooling action Overlapping area are:(SV-OLPA)~(SV+OLAP)
AtDL	Autotune offset	0-199 C	0	The auto-tune offset will shift the SV value down by the AtDL value during the autotune process. that will prevent the system from damage due to overshooting during the autotune process
CYt1	Cycle time for OUTPUT 1	0 to 999 Sec	20	Cycle time for OUTPUT1, Set as 20 seconds for relay output Set as 2 seconds for SSR Drive output
HYS1	HYS1 for OUT 1 ON/OFF mode	0.0 to 100.0	1.0	Control mode switch to ON/OFF mode for Output 1 when P1=0, the Hysteresis is HYS1 value,For heating application: OP1 off when PV>SV, OP1 on when PV<SV-HYS1. For cooling application:OP1 on when PV>SV+HYS1, OP1 off when PV<SV
P2	P2 for output 1 (cooling output)	0.0~200	20	Proportional band for output 2, Control mode switch to ON/OFF mode when P2=0.0, Set P2=2.0 for analog signals
i2	I2 for output 1 (cooling output)	0~3600 Sec	210	Integral time for OUTPUT 2, Integral action off when i2=0,the smaller the i1value is, the stronger integral action will be for the system, but system will be less stable
d2	d2 for output 1 (cooling output)	0~3600 Sec	30	Derivative time for OUTPUT 2, derivative action off when d2=0 the greater the d1value is, the stronger derivative action will be for the system, but system will be less stable
CYt2	Cycle time for OUTPUT 2	0 to 999	20	Cycle time for OUTPUT2(cooling), Set as 20 seconds for relay output Set as 2 seconds for SSR Drive output
HYS2	HYS2 for OUT 2 (cooling)ON /OFF mode	0.0 to 100.0	1.0	Control mode switch to ON/OFF mode for Output 2 when P2=0, the Hysteresis is HYS2 value.OP2 on when PV>SV+GAP2+HYS2 OP2 off when PV<SV+GAP2
GAP2	Offset for SV of cooling side	0.0-200.0	0.0	This parameter defines the setting value for cooling action of Output 2 SV for cooling=SV+GAP2 e.g. SV=100, GAP2=10, then the SV for cooling will be 100+10=110℃ or℉
rE	Reserved parameter	0.0 to 100.0	10.0	Parameter reserved for customized function
rSt1	Overshoot suppression for Output1	-30 to 30	-5.0	This parameter used to suppress the overshoot at the first round of heating up process,Best way to determine the value of this parameter is by auto-tuning(the smaller the value is, the faster the heat up will be)
rSt2	Overshoot suppression for Output 2	-30 to 30	-5.0	Op2 was used as overshoot suppression for output 2 when I2=0 and d2=0, this only applies to Output 2 for cooling action the smaller the value is, the faster the cooling will be
OPL	Lower limit of Output 1	0.0 to 100.0%	0.0	This parameter defines the lower limit output for Output 1
OPH	higher limit of Output 1	0.0 to 100.0%	100.0	This parameter defines the higher limit output for Output 1
OPL2	Lower limit of Output 2	0.0 to 100.0%	0.0	This parameter defines the lower limit output for Output 2
OPH2	Higher limit of Output 2	0.0 to 100.0%	100.0	This parameter defines the higher limit output for Output 2
PUo	Initial output ratio for output 1	0.0 to 100.0%	0.0	This parameter defines the initial output ratio for Output 1when controller has the manual output feature right after power on
bUFF	Soft-start function for output 1	0.0 to 100%	100.0	This function only applies to analog output, it restrain the output variance at a preset ratio 100% means no soft-start function, e.g. buF=5% , means the variance ratio of the output will be at 5% maximum
SSV	Preheating Setting Value	-1999~9999	0	1: In heating application, when PV<SSV value , the preheating will be activated right after power on,In cooling application, when PV> SSV value,the preheating will be activated right after power on 2:The MAN indicator flashes and the output power defined by "SouT" value 3:In heating process,Preheating terminated when PV≥SV or preheating operated time reaches to StME value(for heating) In cooling process,Preheating terminated when PV≤SV or preheating operated time reaches to StMe value(for cooling) 4:When StME=0, preheating function off 5: MAN indicator stop flashes when preheating off
StME	Preheating running period			
Sout	Output power during preheating process			
LCK	Configuration previlidge	0000-0255	0	LCK=0000, all parameters can be modified LCK=0001,only SV can be modified LCK=0010, only SV and parameters under level 1 can be modified LCK=0011,all parameters are locked LCK=0101,all parameters can be modified, access to parameter level 3

Remark: Not all parameters will be available for configuration, some of parameters won't be available depends on different function Refer to "8" "9" and "10" for detailed information on specific parameters, Same of parameters such as Op2 for cooling and analog output has to be specifie before order with special software and hardware included. Please check our catalogs for detailed ordering information

5.3 Parameter Level 3

5.3.1 How to access to parameter level 3

1). Follow the instruction in 5.2 and goes to parameter level 2, put 0101 as the value for parameter LCK,Pree SET key for 3 seconds to go back to PV/SV mode
2).Press SEK and key simutaneously for 3 seconds to access to parameter level 3 below parameters will be displayed one by one by pressing SET key.

1# Factory default

Notation	Name	Range	1#	Description
INP 1				

sensor notation	E1	E2	E1	E2	J1	J2	N	U
sensor type	K	K	E	E	J	J	N	Wu3_Re25
Range	400.0 ℃	1300 ℃	300.0 ℃	600 ℃	400.0 ℃	800 ℃	1300 ℃	2000 ℃

sensor notation	S	t	r	b	AN4	AN3	AN2	AN1	Pt1	Pt2
sensor type	S	T	R	B	2-10VDC 1-5VDC 4-20mA	0-10VDC 0-5VDC 0-20mA	0-50mV	0-20mV	Pt100	Pt100
Range	1600 ℃	400.0 ℃	1700 ℃	1800 ℃					-199.9~200.0 ℃	-200~800 ℃

Remark: Input sensor is field selectable via front panel between all RTD and TC sensors,analog signal has to be specified before order except 0-20mA and 0-50mA

dP	Decimal points for analog inputs	0,1,2,3	0	0: W/O decimal points 1: 1 decimal points 2: 2 decimal points 3:3 decimal points (this is for analog inputs only)
LSPL	Lower limit for SV	-1999~9999	0	define the lower limit of SV or Zero point for re-transmission
USPL	Higher limit for SV	-1999~9999	400	define the higher limit of SV or full scale for re-transmission
UNIT	Display units	0,1,2	0	0: Celcius 1: Fahrenheit 2: No units
PVOS	Input offset	-199~199	0	Calibration offset, PVOS is used to set an input offset to compensate the error produced by sensors.For example, If the controller display 5 C when probe was in water/ice mixture, Set PVOS=-5 will make the controller display 0 C
PFLt	Digital filter strength	0 to 66	55	1-30 Normal filter strength 31-60 enhanced filter strength The greater the value is , the stronger the filter strength will be. stronger filtering strength increase the stability of the readout but cause more delay in the response to changes in the temperature
ANL1	lower limit display for analog input	-199~9999	0	E.g. for 4-20mA input, the display will be ANL1 when input is 4 mA
ANH1	Higher limit display for analog input	-199~9999	2000	E.g. for 4-20mA input, the display will be ANL2 when input is 20 mA
ALd1	Alarm mode for alarm 1	00 to 16	11	To define the alarm mode for 1st alarm, refer to alarm description table for details
AH1	Hysteresis for alarm 1	0.0 to 100.0	0.4	To define the hysteresis for 1st alarm, (high alarm: negative hysteresis, low alarm: positive hysteresis)
ALd2	Alarm mode for alarm 2	00 to 16	10	To define the alarm mode for 2nd alarm, refer to alarm description table for details
AH2	Hysteresis for alarm 2	0.0 to 100.0	0.4	To define the hysteresis for 2nd alarm, (high alarm: negative hysteresis, low alarm: positive hysteresis)
ALd3	Alarm mode for alarm 3	00 to 16	10	To define the alarm mode for 3rd alarm, refer to alarm description table for details
AH3	Hysteresis for alarm 3	0.0 to 100.0	0.4	To define the hysteresis for 3rd alarm, (high alarm: negative hysteresis, low alarm: positive hysteresis)
OUd	Control action configuration	0 or 1	0	0: Reverse action (Heating) 1: Direct action(cooling)
SSrn	SSRM SCR trigger mode	PHAS or CYCL	PHAS	PHAS=Phase angled trigger mode CYCL=Full wave trigger mode
bEr	Soft-start configuration	0,1,2	0	0: Soft-start function off 1: Soft-start function on 2: Soft-start function on when output increase, soft-start off when output decrease The output variance percentage was defined under parameter buFF from parameter level 1
Hz	HZ Power frequency for SCR trigger type	50HZ or 60HZ		50HZ: 50HZ frequency 60HZ: 60HZ frequency
Idn0	Device address	0-127	1	A unique address will be assigned to each controller with RS-485 communication
bAUd	Communication baud rate	0,1,2,3	2	Baud rate=0 2.4K, Baud Rate=1 4.8K Baud rate=2 9.6K Baud Rate=3 19.2 K

**Alarm mode description (ALd_=00~16)

10: No alarm output	00: No alarm output
11: Deviation high alarm	01: Deviation high alarm with hold action
12: Deviation low alarm	02: Deviation low alarm with hold action
13: Deviation high/low alarm	03: Deviation high/low alarm with hold action
14: Deviation band alarm	04: Deviation band alarm with hold action
15: Process high alarm	05: Process high alarm with hold action
16: Process low alarm	06: Process low alarm with hold action

NOTE: The alarm action will be suppressed right after power on even the condition is satisfied, and the alarm standby only works 1 time right after power on. the alarm will go off if the condition satisfied again after suppression at the first time

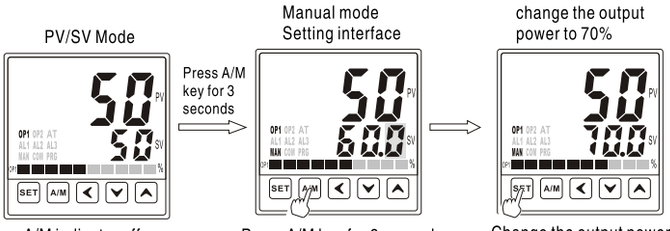
5.3.2 Alarm mode description Table

Code	ALD□	Specification(Example for alarm 1)
N	10 or 00	No alarm
A	11	AL1≥0: Deviation high alarm — AH1, Alarm ON, LOW, SV, SV+AL1, HIGH
		AL1<0: Deviation high alarm — AH1, Alarm ON, LOW, SV+AL1, SV, HIGH
B	12	AL1≥0: Deviation low alarm — Alarm ON, AH1, LOW, SV, SV+AL1, HIGH
		AL1<0: Deviation low alarm — Alarm ON, AH1, LOW, SV+AL1, SV, HIGH
C	13	Deviation high/low alarm — Alarm ON, AH1, AH1, Alarm ON, LOW, SV-AL1, SV, SV+AL1, HIGH
D	14	Deviation band alarm — Alarm ON, LOW, SV-AL1, SV, SV+AL1, HIGH
H	15	Process high alarm — AH1, Alarm ON, LOW, AL1, HIGH
J	16	Process low alarm — Alarm ON, AH1, LOW, AL1, HIGH
E	01	AL1≥0: Deviation high alarm with hold action — AH1, Alarm ON, LOW, SV, SV+AL1, HIGH
		AL1<0: Deviation high alarm with hold action — AH1, Alarm ON, LOW, SV+AL1, SV, HIGH
F	02	AL1≥0: Deviation low alarm with hold action — Alarm ON, AH1, LOW, SV, SV+AL1, HIGH
		AL1<0: Deviation low alarm with hold action — Alarm ON, AH1, LOW, SV+AL1, SV, HIGH
G	03	Deviation high/low alarm with hold action — Alarm ON, AH1, AH1, Alarm ON, LOW, SV-AL1, SV, SV+AL1, HIGH
M	04	Deviation band alarm with hold action — Alarm ON, LOW, SV-AL1, SV, SV+AL1, HIGH
K	05	Process high alarm with hold action — AH1, Alarm ON, LOW, AL1, HIGH
L	06	Process low alarm with hold action — Alarm ON, AH1, LOW, AL1, HIGH

NOTE: The alarm action will be suppressed right after power on even the condition is satisfied, and the alarm standby only works 1 time right after power on. the alarm will go off if the condition satisfied again after suppression at the first time

6. Auto/Manual bumpless transfer

All models has a A/M key where you can switch the control mode whenever you want, the transfer is bumpless transfer, e.g. if the controller at 75% of power at PID mode, it will stay at 75% of power when it is switched to manual mode until it is manually adjusted. below is an example of changing the PID mode to manual mode and set the output at 70% of power



A/M indicator off under PV/SV mode

Press A/M key for 3 seconds Switch to manual control mode MAN indicator light up, lower display shows the current output percentage, the very right of the digits flashing means that the digits can be modified

Change the output power to 70%, Press SET key to exit. Controller now works as a manual mode controller,Man indicator lights up and output power as 70%

Remark:

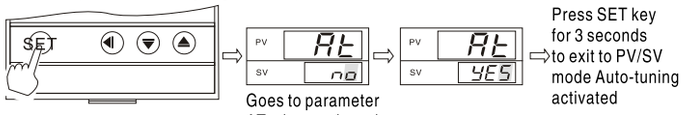
Press A/M key at manual mode for 3 seconds can switch back to PID mode

The control mode can be set as manual mode automatically right after power on, and the output power can be defined under parameter Pk0 from parameter level 2

A/M key can be used to save a modification which you made on the parameter during the configuration

7. Auto-tuning

Always recommended to performance auto-tuning in a new application.The best time to start the auto-tuning is right after power on when process value is far away from the Setting value this will help the auto-tuning to get most optimized auto-tune result



Press SET once and goes to parameter level 1

Goes to parameter AT, change the value to YES

Press SET key for 3 seconds to exit to PV/SV mode Auto-tuning activated

Remark:

1:AT indicator flashing after auto-tuning initiated, goes to parameter AT and change the AT value to NO if you want to turn off the auto-tuning

2:Auto-tuning is an ON/OFF control mode, significant temperature oscillation is expected and the time duration for the auto-tuning could be extra long then expected depends on different system

3:AT indicator stop flashing after autotune finished, P1, I1,d1, rE and rSt1 value was calculated automatically during the autotune process.controller goes back to PV/SV mode and with all the mentioned parameter saved with a new value. Controller starts to control the system with new parameter

4:For some of specific system where the control effect has not been improved after autotune, we recommend to manual fine tune the P.I.D and other parameters to have a better control effect

5:P1 is the proportional band of the Output 1, it's value should fall into the range of SV -/+ P1/2, The P1 should be set as 10% to 15% of SV when manually set the P1

6:I1 is the integral time for the Output 1, the factory default is 200, the integral action gets stronger when I1 gets smaller, controller has a better responding to temperature changes with a small I1 value, but it will cause temperature oscillation around the Set point

below points are things you should know about on adjusting the I1 value

(1)If the heat up is slow and the output has not increased significantly, try to decrease the I1 see if it improves

(2)If the heat up is very rapid and output still there, try to decrease the I1 value to counterbalance it

(3)If the temperature oscillate around the SV, try to increase the I1 value to counterbalance it

7:d1 is the derivative time for output 1, normally the value should be at 20%~30% of the I1 value, derivative action was to balance the overact that integral had on the system, the derivative action gets stronger when d1 gets greater

(1)Mannually increase the d1 value If the heat up is too fast after proportional action kick in, and overshoot was caused. take the same steps and increase the d1 value if the cooling down is too fast and undershoot was created.

(2)In some of application where the controlled object is too sensitive on even a small variance of output. should decrease the d1 value even consider to set d1=0 to have a stable control, this applies to some typical application such as constant water supply system

8:Parameter rE is used to suppress the overshoot of the first round heat up. or overshoot caused by changing the setting value, this parameter kick in at the first round heat up and dismissed after SV reached. Increase the rE value will make the chance of overshoot gets smaller, but the output power will be small and heat up gets slower

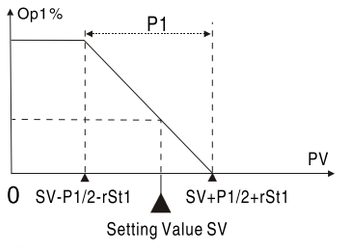
9:rSt1 is the offset value for proportional band of Op1, it will make the system more stable in a time proportional control system, adjust the rSt1 value will make the system stable as soon as possible in a PID control case.

(1)rSt1 set as 0 in a heating application with stronger heating inertia effects, set rSt1>-P/2 when manually adjust the rSt1, e.g.P1-30.0, rSt1>-15, normally rSt1>-30%P1, heating gets slower when decrease the rSt1 value

(2)On the contrary, rSt1 set as positive value in cooling application, cooling gets slower when rSt1 value increase

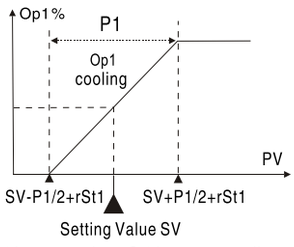
8. Various Control Mode

(1)OP1,PID reverse control(heating)
PV increase and OP1 decrease



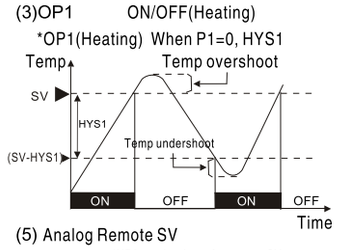
P1 decrease when rSt1 decrease, heating gets slower

(2)OP1,PID direct control(cooling)
PV increase and OP1 increase

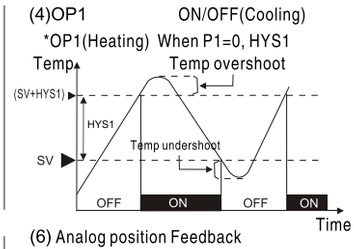


P1 increase when rSt1 increase, cooling gets slower

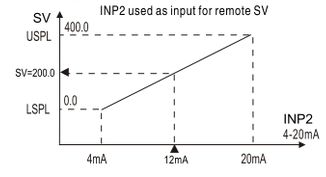
(3)OP1 ON/OFF(Heating)



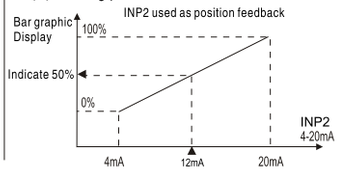
(4)OP1 ON/OFF(Cooling)



(5) Analog Remote SV



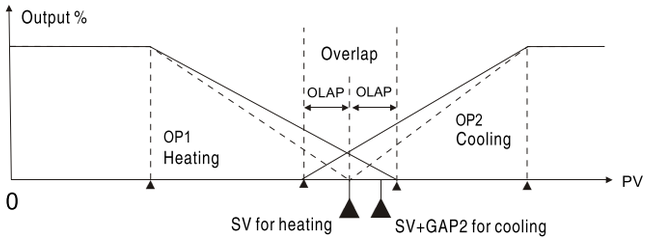
(6) Analog position Feedback



9. Dual output heating and cooling control

If the controlled object has a temperature overshoot tendency during the heating process, and natural cooling is not sufficient, a heating+cooling control mode will help in this case, Parameter OLAP is used to define the overlap area between cooling and heating

no overlap area if OLAP=0



Parameters P2,I2,d2 is used to define the control mode of Op2 such as P.I.D control, time proportional control or ON/OFF control

10. RS-485 Communication

(1) Support Modbus-RTU protocol, support 03 read command, 06 and 10 write command

(2) Communication mode: single-master Rs485 asynchronous serial communication baud rate: 2400, 4800,9600,19200(9600 baud rate is factory default value)

Format: 1 start bit+ 8 digital bit+N+1 stop bit
1 start bit+8 digital bit+N+2 stop bit

(3)The maximum write command for the controller is 36 at once, maximum read command is 37 at once for the read command

(4)For more details, refer to communication details of FTseries

Series LCT216 Timer/Counter/Tachometer

Specifications - Installation and Operating Instructions

LOVE CONTROLS DIVISION
DWYER INSTRUMENTS INC.
P.O. BOX 338 - MICHIGAN CITY, INDIANA 46360, U.S.A.

Phone: 219/879-8000 www.love-controls.com
Fax: 219/872-9057 e-mail:love@love-controls.com

TABLE OF CONTENTS

MODEL NUMBER IDENTIFICATION

LCT216 — □ □ □

Power Supply	Output Type	Communications
1 = 100 to 240 VAC	0 = Transistor	0 = None
	1 = Relay	

GETTING STARTED

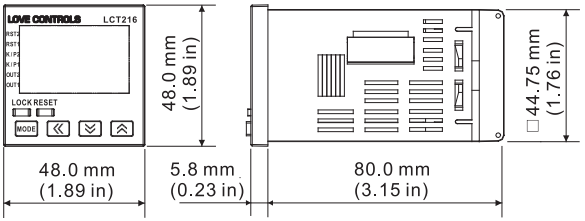
1. Install the control as described on page 4.

2. Wire your control following the instructions on page 5. Please read the Precautions section located at the end of this manual before wiring the control.

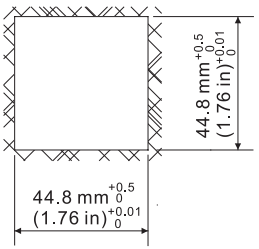
INSTALLATION

Mount the instrument in a location that will not be subject to excessive temperature, shock, or vibration. All models are designed for mounting in an enclosed panel.

Select the position desired for the instrument on the panel. Prepare the panel by cutting and deburring the required opening per the panel cut out dimensions listed below. Follow the mounting instructions listed on page 4. Lastly, wire the controller per the appropriate wiring diagram listed on page 5.



Physical Dimensions



Panel Cut Out

MOUNTING METHOD

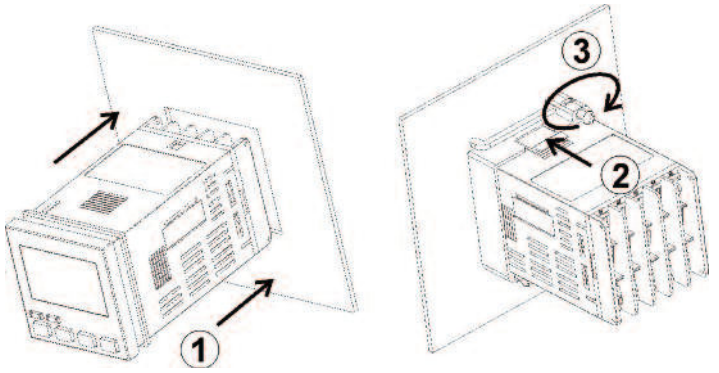
Step 1: From the front of the panel, slide the controller housing through the cut out. The housing gasket should be against the housing flange before installing.

Step 2: Slide the mounting collar over the housing from the rear of the panel.

Step 3: Push the mounting collar forward until the bracket stops at the panel wall.

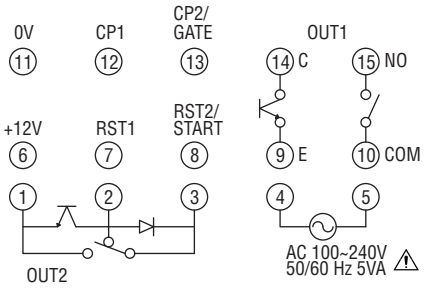
Step 4: Insert and tighten the screws on the bracket to secure the controller in place. (The screw torque should be 0.8 kgf-cm).

Mounting Bracket Installation



WIRING

Terminal Identification

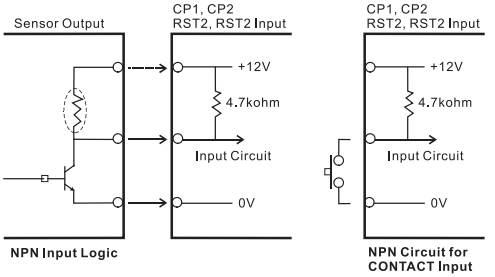


Multi-Function Input PIN

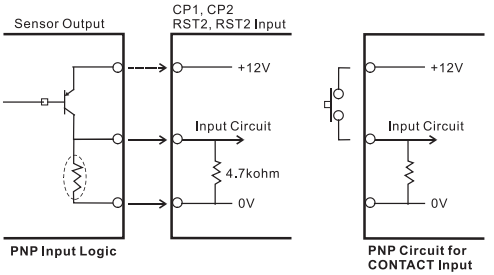
Counter	Timer	Tachometer	Timer & Counter
CP1		CP1	CP1
CP2	Gate		Gate
Reset1	Reset1	Reset1	Reset1
Reset2	Start		Start

Input Connections

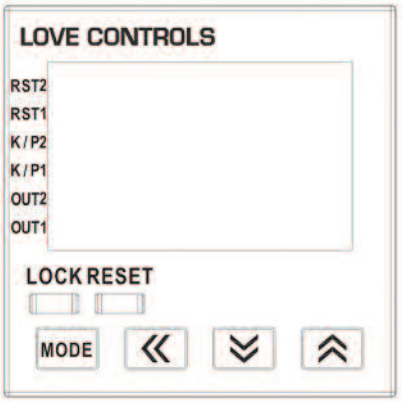
NPN



PNP



FRONT KEY FUNCTIONS



Key functions are as follows:

MODE: Pressing the Mode key advances the display to the next menu item and saves any changed parameter values.

UP ARROW: Increments a value or changes a menu item. If pressed while in the home display, the set point value will be increased.

DOWN ARROW: Decrements a value or changes a menu item. If pressed while in the home display, the set point value will be decreased.

LEFT ARROW: Changes the selected digit to the left. This is used to quickly change set point values for large values.

RESET: Clear and reset the PV display.

LOCK: Press to enter secure mode. See Security Feature section for more information.

SECURITY FEATURES

The Series LCT216 has two built-in security lock settings to prevent unauthorized personnel from changing parameter settings.

The LoC1 setting affects all parameters in the controller. If LoC1 setting is enabled, the operator will have to unlock the controller to make any changes to the controller's parameters

The LoC2 setting affects all parameters except the set point and the reset function. If LoC2 setting is enabled, the only parameters that the operator will be able to change are the set point and resetting the process value. In order to change any other parameters, the operator will have to unlock the control before making a change.

In order to unlock the control, the operator must depress the MODE and LEFT ARROW key simultaneously.

CONTROL OPERATION DESCRIPTION

Home Display

The HOME display is the normal display while the control is operating. If no errors or functions are active, the HOME display will indicate the process value on the top display and the set value on the bottom display. Below the set value, the current mode of operation will be shown as TAC (tachometer), CNT (counter), or TMR (timer). There will also be a descriptor for the time units and type of counter operation.

While in the HOME display, the user can use the UP ARROW, DOWN ARROW, and LEFT ARROW keys to change the set point value. The RESET key will clear the process value. The LOCK key will enable the security feature.

Parameter Configuration Display

Holding the MODE KEY for 3 seconds will enter the parameter configuration display. Once in the parameter configuration display, the parameter will be listed in the top display and the value of that parameter will be listed in the bottom display. Pressing the MODE key will cycle through the parameters for the respective operation modes. The UP and DOWN arrows change the values of the parameters. The MODE key must be pressed to save any changes. Return to the HOME display by holding the MODE key for 3 seconds.

TIMER SETTINGS

The timer function of the series LCT216 takes a signal input to start a timing sequence. The sequence can be paused using the GATE input or reset using RST1 input. Use the below parameters and timing functions to configure the timer.

Parameter Configuration

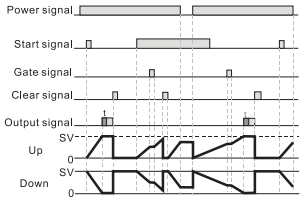
PV	SV	
FUnC	timE	Sets the controller to function as a timer.
t mode	UP down	Sets the display to count up or down.
t otmd		Sets the output timing functions. See the timing functions section or page 9 for detail description of each timing function.
t Unit		Sets the display units of measure. See below table for a list of the available units.

Display	Units	Range	Resolution	Maximum Time
S 001	sec.	0.01 to 9,999.99	10 msec.	9,999.99 sec.
S 01	sec.	0.1 to 99,999.9	0.1 sec.	99,999.9 sec
S 1	sec.	1 to 999,999	1 sec.	999,999 sec.
mS 001	min., sec.	0.01 to 9,959.99	10 msec.	5,999.99 sec.
mS 01	min., sec.	0.1 to 99,959.99	0.1 sec.	59,999.9 sec.
m 01	Min.	0.1 to 99,999.9	0.1 min.	99,999.9 min.
M 1	Min.	1 to 999,999	1 min.	999,999 min
HmS	Hr., min., sec.	1 to 995,959	1 sec.	359,999 sec. (100 hr.)
Hm 1	Hr., min.	1 to 999,959	1 min.	599,999 min. (10,000 hr.)
H 1	Hr.	1 to 999,999	1 hr.	699,999 hr.

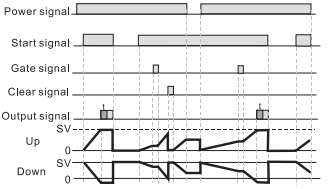
Table A: List of Timing Units

T oUt 1	Sets the pulse width (t) for output 1. The default output timeis 0.02 seconds. If you wish the system to keep the operation of the output, please set the output time to 0.00 seconds.
rtSr	Sets the minimum pulse width at either 1 msec or 20 msec.
inPtLC	Sets the transistor input type to NPN or PNP. For contact input, the selection can be either PNP or NPN, but the selection will determine whether the connection is to terminal 11 or terminal 6. See the input connection diagrams on page 5.

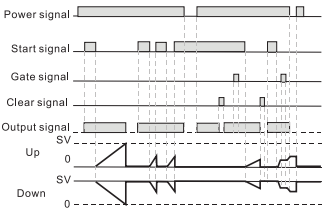
Timer Functions



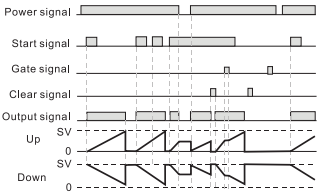
Signal On Delay 1 Sond1



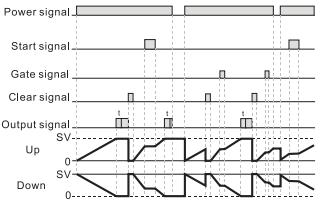
Signal On Delay 2 Sond2



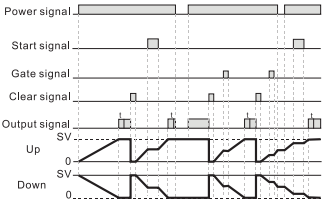
Signal Off Delay SoFFd



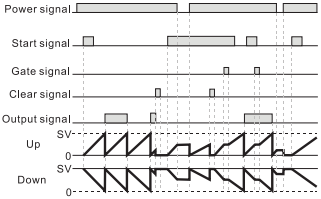
Signal On Son



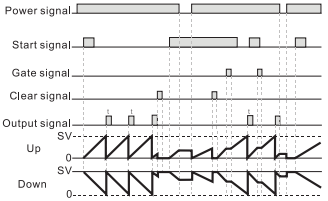
Power On Delay Pond



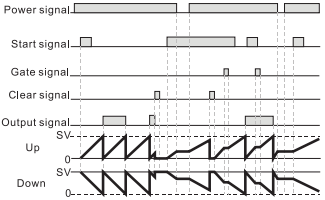
Power On Delay Hold PondH



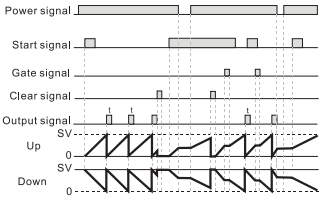
Repeat Cycle rCy timer output set to 0



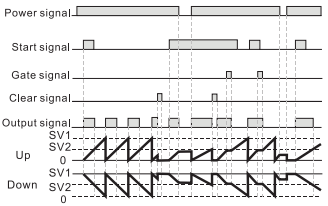
Repeat Cycle rCy timer output not set to 0



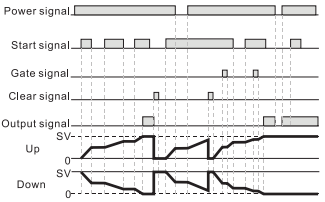
Repeat Cycle Hold rCyH Timer output set to 0



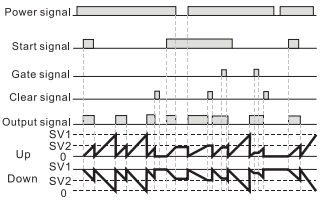
RCYH timer output not set to 0 rCyH



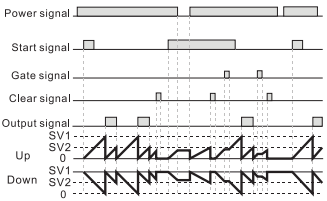
Repeat Cycle 2 rCy2



Signal Cumulate SCon



Signal Twin ON-Start SCon



Signal Twin OFF-Start SCoFF

COUNTER SETTINGS

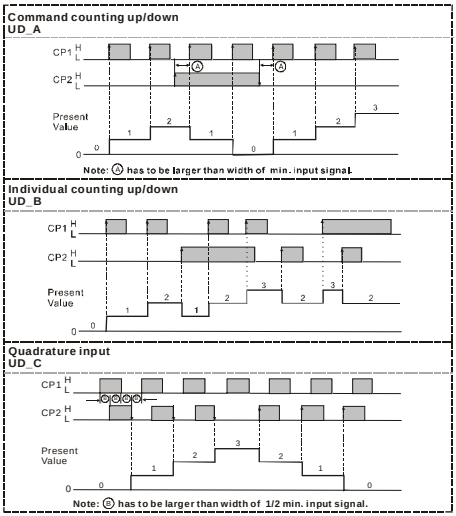
Parameter configuration

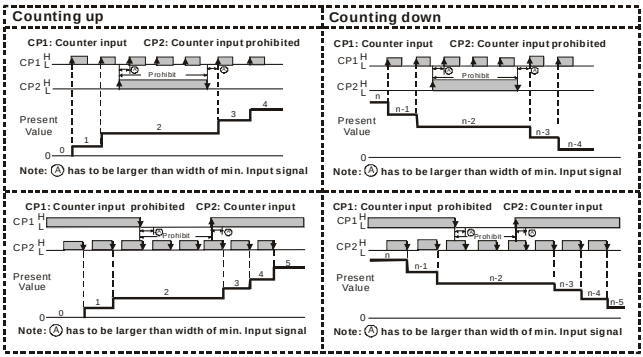
PV	SV	
FUnC	Cont	Sets the controller to function as a counter
CntFUn		Select the counter to perform single stage counting, two stage counting, batch counting, total counting or dual counting.
	STAGE1	Controller has a single process value and set point value. Output 2 will be the same as output 1.
	STAGE2	Controller has up to two set point and process values. The operation is based on the input modes and output types.
	bAtCH	Controller can be set to count batch processes. In this mode, the counter will count up until it reaches the set value and then will increment the batch present value by one. The process will continue until the batch set point value is reached.
	totAL	Controller has a single set point. The display can show the present value since last reset or total counts.
	dUAL	Controller will either add or subtract the counts from the two counter inputs.
C inPt		Counter input mode can be selected to count up or down when a counter input signal is received.
	UP	The present value will increase with each counter input signal.
	doun	The present value will decrease with each counter input signal.

Ud A Command up / down setting will increase or decrease the present value with each counter 1 input signal depending on if counter 2 input is engaged. When counter 2 input is engaged, each counter 1 input signal will decrease the count.

Ud b Individual up / down setting will increase the present value with each counter 1 input signal and decrease with each counter 2 input signal.

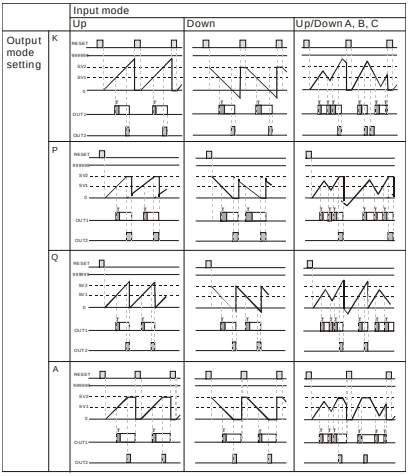
Ud C Quadrature up / down uses the order of the inputs to determine whether to count up or down. If counter input 1 leads counter input 2, the unit will count up. If counter input 2 leads counter input 1, the unit will count down.

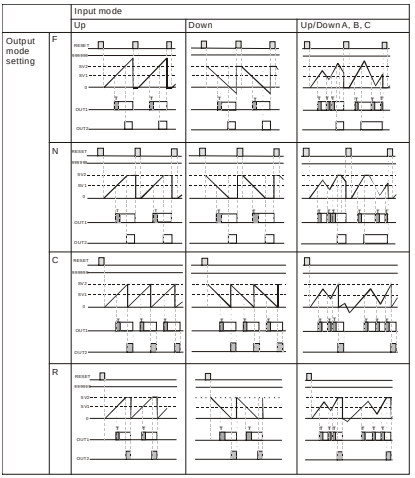


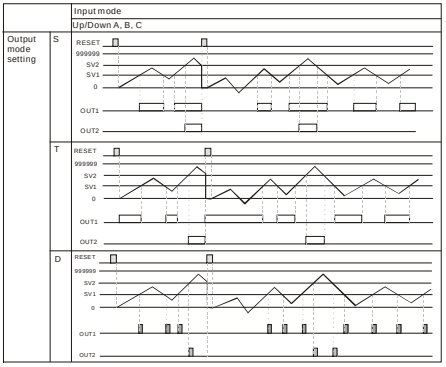


C otmd		Counter Output Mode determines the output operation of the control. It also determines how the counter will function after reaching the set point. See the output mode charts on page 13 for more information.
C SPEd		Counting Speed can be set from one count per second up to 10,000 counts per second. This setting determines the minimum input signal width.
t oUt1		Sets the pulse width (t) for output 1.
t oUt2		Sets the pulse width (t) for output 2.
Point		Sets the number of digits to the right of the decimal point on the display.
PSCALE		Pre-Scale is used when converting the process value's units of measure. The pre-scale value would be set as the conversion factor. (Pv = Pv * PSCALE)
PwErS		Power Save feature allows the control to save the current process value upon loss of power.
	SAvE	Save process value upon power loss
	CLEAr	Clear process value upon power loss
rtSr		Minimum width of reset signal determines how long the reset terminals must be engaged to reset the device.
inPtLC		Input signal can be set for PNP or NPN. This parameter determines which wiring diagram should be used.

Counter Output Mode Charts





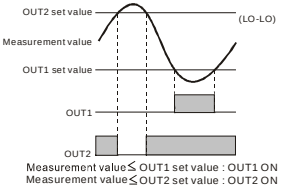


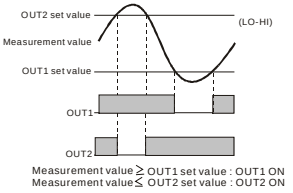
Output Modes S, T, and D can only be used with up/down counting inputs.

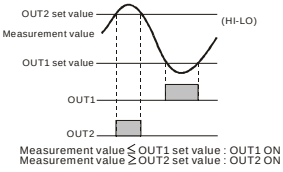
TACHOMETER SETTINGS

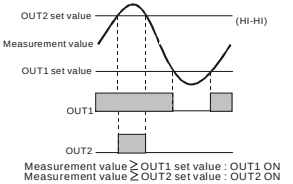
Parameter Configuration PV	SV	
FUnC	tACH	Sets the controller to function as a tachometer.
tAotmd		Tachometer Output Mode determines the output condition when the process value exceeds the set point value. See output mode charts below for more information.
C SPEd		Maximum Input Frequency can be set from one count per second up to 10,000 counts per second.
Point		Sets the number of digits to the right of the decimal point on the display.
PSCALE		Pre-Scale is used when converting the process value's units of measure. This value is commonly used to convert the input frequency (counts per second) to a rotational speed (rpm) using the below equation. Frequency (Hz) * Pre-Scale = Rotation Speed (rpm) Pre-Scale = 60 / n (where n = number of pulses per revolution).
St tAC		Initial Power Up Interrupt delays the output from triggering for up to 99.9 seconds.
St AvG		Input Filter allows the tachometer to average 2, 4, or 8 readings to give a more stable reading. (1= 2 data points, 2 = 4 data points, and 3 = 8 data points).
rtSr		Minimum Width of Reset Signal determines how long the reset terminals must be engaged to reset the device.
inPtLC		Input signal can be set for PNP or NPN. This parameter determines which wiring diagram should be used.

Tachometer Output Mode Charts









TIMER + COUNTER MIXED MODE SETTINGS

Parameter Configuration PV	SV	
FUnC	miX	Sets the controller to function as a timer and counter.
T mode		Timer Mode sets the timer to count up or Down.
T otmd		Timer Output Mode sets the output timing functions. See the timing functions section on page 9 for detail description of each timing function.
t Unit		Sets the display units of measure. See table A on page 8 for a list of the available units.
C inPt		Counter input mode can be selected to count up or down when a counter input signal is received.
	UP	The present value will increase with each counter input signal.
	doun	The present value will decrease with each counter input signal.
C otmd		Counter Output Mode determines the output operation of the control. It also determines how the counter will function after reaching the set point. See the output function tables on page 13 for more information.
C SPEd		Counting Speed can be set from one count per second up to 10,000 counts per second. This setting determines the minimum input signal width.
t oUt1		Sets the pulse width (t) for output 1.
t oUt2		Sets the pulse width (t) for output 2.
Point		Sets the number of digits to the right of the decimal point on the display.
PSCALE		Pre-Scale is used when converting the process value's units of measure. The pre-scale value would be set as the conversion factor. (Pv = Pv * PSCALE).

PuErS — Power Save feature allows the control to save the current process value upon loss of power.

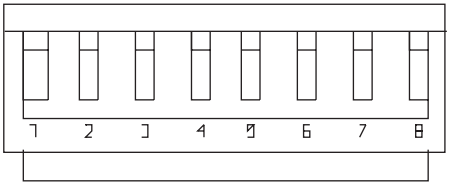
- SAvE — Save process value upon power loss
- CLEAr — Clear process value upon power loss

rtSr — Minimum width of reset signal determines how long the reset terminals must be engaged to reset the device.

inPtLC — Input signal can be set for PNP or NPN. This parameter determines which wiring diagram should be used.

DIP SWITCH SETTINGS

The Series LCT216 can be configured either using the configuration parameters discussed in the previous section or by using DIP switches located on the side of the housing. When the DIP switch setting is turned on, the parameters can be viewed, but not changed using the front panel.



SW	Counter	Timer	Tachometer
8	Reset Pulse Width On = 1 ms, Off = 20 ms	Reset Pulse Width On = 1 ms, Off = 20 ms	Reset Pulse Width On = 1 ms, Off = 20 ms
7	Input Type On = PNP, Off = NPN	Units of Timer See Table C	Input Type On = PNP, Off = NPN
6	N/A	Units of Timer See Table C	N / A
5	Counting Speed On = 10K CPS, Off = 30 CPS	Units of Timer See Table C	Counting Speed On = 10KHz, Off = 30 Hz
4	Output Mode of Counter See Table D	Output Mode of Timer See Table D	Output Mode of Tachometer See Table D
3	Output Mode of Counter See Table D	Output Mode of Timer See Table D	Output Mode of Tachometer See Table D
2	Input Mode of Counter On = Down, Off = Up	Time Counting Up/Down On = Down, Off = Up	N / A
1	On = Enable DIP Switch Off = Disable DIP Switch	On = Enable DIP Switch Off = Disable DIP Switch	On = Enable DIP Switch Off = Disable DIP Switch

Table B: DIP Switch Parameter List

SW5	SW6	SW7	Displayed Unit
OFF	OFF	OFF	0.01 s
ON	OFF	OFF	0.1 s
OFF	ON	OFF	1 s
ON	ON	OFF	min, 0.01 s
OFF	OFF	ON	min, 0.1 s
ON	OFF	ON	0.1 min
OFF	ON	ON	min
ON	ON	ON	hr, min, s

Table C: Timer Units of Measure

		Output Mode Configuration		
SW3	SW4	Counter	Timer	Tachometer
OFF	OFF	F	Signal ON Delay 1	Lo-Lo
ON	OFF	N	Signal ON Delay 2	Lo-Hi
OFF	ON	C	Signal OFF Delay	Hi-Lo
ON	ON	R	Signal ON	Hi-Hi

Table D: Output Mode Configurations

SPECIFICATIONS

Operating Temperature Range: 32 to 122°F (0 to 50°C).
Humidity Conditions: 35 to 85% RH (non-condensing).
Control Output Ratings: (Out 1) Relay: SPST 5A at 250 VAC, Transistor: NPN Open collector 100 mA / 30 VDC residual voltage = 1.5 VDC max; (Out 2) Relay: SPST 5A at 250 VAC, Transistor: NPN Open collector 100 mA / 30 VDC residual voltage = 1.5 VDC max.
Weight: 4 oz (114 g).
Reset Time: 0.001 seconds minimum.
Inputs: Dry contact, PNP, or NPN.
Timing Functions: 14 pre-programmed timing functions.
Supply Voltage: 100 to 240 VAC 50 / 60 Hz.
Power Consumption: Less than 10 VA.
Internal Power Supply: 12 VDC ±10%, 100 mA..
Display: Two-line 6 digit negative transmissive LCD display.
Agency Approvals: CE, UL.

DANGER 1. When the power is on, DO NOT touch the AC terminals in case an electric shock may occur.
2. Make sure the power is disconnected when you check the unit inside.

WARNING LCT216 is an OPEN-TYPE device. They are intended for installation completely within an overall panel and for use in counting or timing applications. If it will cause series injury to workers or damages on other equipment when used in a dangerous environment, please make sure it is installed in an automatic safety protection device.

1. Always use recommended solder-less terminals: Fork terminals with isolation (M3 screw, width 7.0 mm), hole (diameter 3.2 mm). Screw size: M3x6.5 (with 6.8x6.8 square washer). Recommended tightening torque: 0.4 N.m (4kgf.com). Applicable wire: solid/twisted wire of 2 mm2, 12 AWG to 24 AWG. Please be sure to tighten them properly.
2. Prevent dust or metallic debris from falling into the device and cause malfunctions.
3. DO NOT modify or uninstall the device.
4. DO NOT use empty terminals.
5. Make sure the wires are correctly connected to proper terminals.
6. Keep away from high-voltage and high-frequency environment during installation in case of interference.
7. Prevent using the device in premises which contain: dust or corrosive gas, high humidity, high radiation, vibration and shock.
8. LCT216 is an open-type device. Make sure to install it in an enclosure to prevent dust, humidity in case of an electric shock.
9. Please make sure the power cables and signal device are installed correctly before switching on the power; otherwise serious damage may occur.
10. DO NOT touch the terminals or repair the device when the power is on; otherwise an electric shock may occur.
11. Please wait for one minute after the power is switched off to allow the capacitor to discharge and DO NOT touch the internal wiring within this period.
12. Use dry cloth to clean the device. DO NOT use acid or alkaline liquid to clean the device.

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LOVE CONTROLS DIVISION
DWYER INSTRUMENTS INC.
P.O. BOX 338 - MICHIGAN CITY, INDIANA 46360, U.S.A.

Phone: 219/879-8000 www.love-controls.com
Fax: 219/872-9057 e-mail:love@love-controls.com

ElectricBrewing
SUPPLY

www.ebrewsupply.com

Electric Brewing Supply, LLC
42021 Willson Memorial Dr
Chassell, Michigan 49916
Phone: 906-523-2344