ElectricBrewing
SUPPLY

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. If at any time you have any questions, please contact us via support@ebrewsupply.com.

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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The Hardware and Tools

DIY Basic kit versus DIY Complete kit

Depending on the kit you have chosen, your included list of hardware will be a complete list or will require you to source additional hardware. Our basic and deluxe 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, we hope you can look upon the project ahead as a jigsaw puzzle. All the pieces you need to complete your controller should have arrived in the package.

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		Yes
Includes Outlets		Yes
Includes Temp Controllers		Yes
Includes Temp Probes		Yes
Includes XLR Inlets		Yes
Includes Wiring		Yes
Includes Elements	No	No

Tools you will need

Not everything will be needed, obviously if you purchased a complete kit, much of the drilling and cutting will have already been completed for you.

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 for DIY work
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 have 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 and DTAPM3C for taps, in addition to 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. It's also to recognize different materials may not need as heavy duty a tool, these are tested with Stainless Steel; steel or plastic usually allows for lessor tools.

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

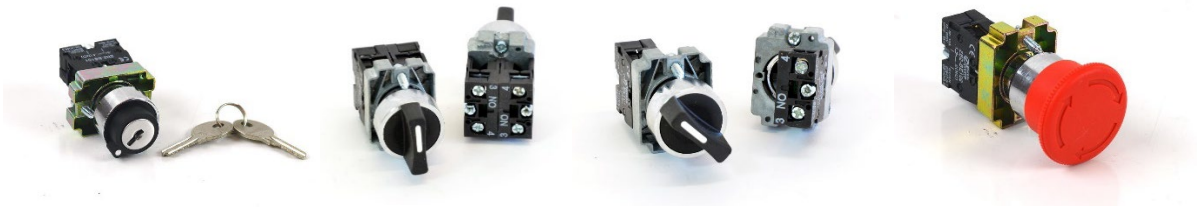
BCS Specific

- 110v White LEDs indicate BCS control assigned for pumps

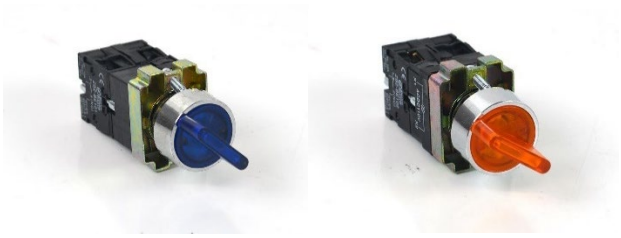
BCS and PID Control Panels

- 220v White LEDs indicate that the Element is actively on
- 110v Yellow LEDs indicate that the element contactors are on
- 12v 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
- Buzzer are for alarm outputs, BCS will be 12v while PID will be 120v

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 e-stop 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 complete kits, 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.

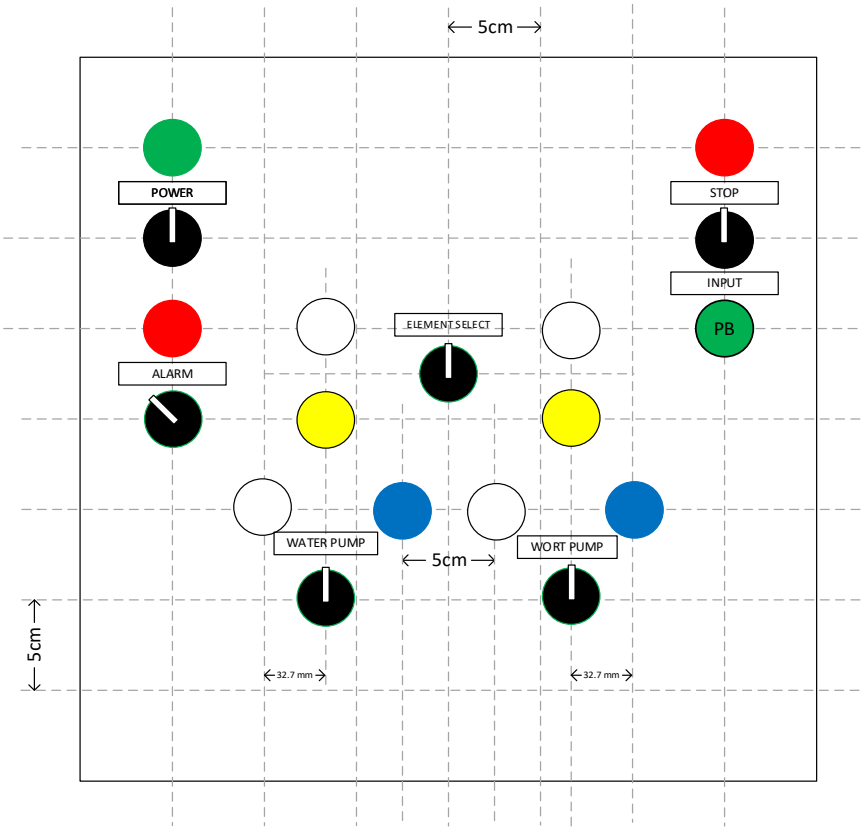
For the 30a control panel the 3 way selection for elements, selects between elements [Boil – Off – HLT] (or vice versa). Otherwise, each 2-way switch is intended for either a pump, an element contactor or an alarm. To make you wiring and layout go smoother, we only use one 2-way switch and daisy connect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

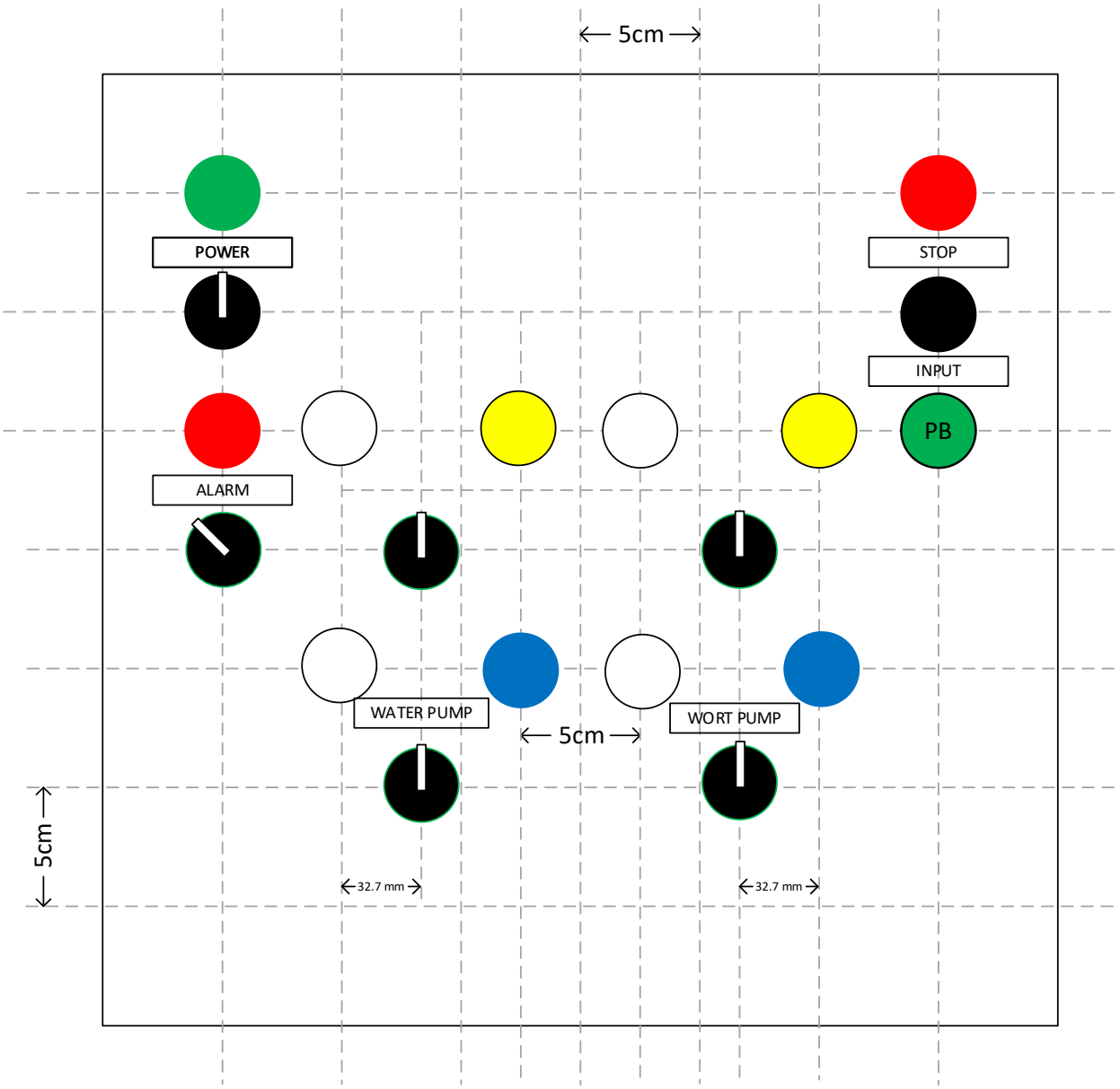
Designing the Layout

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:

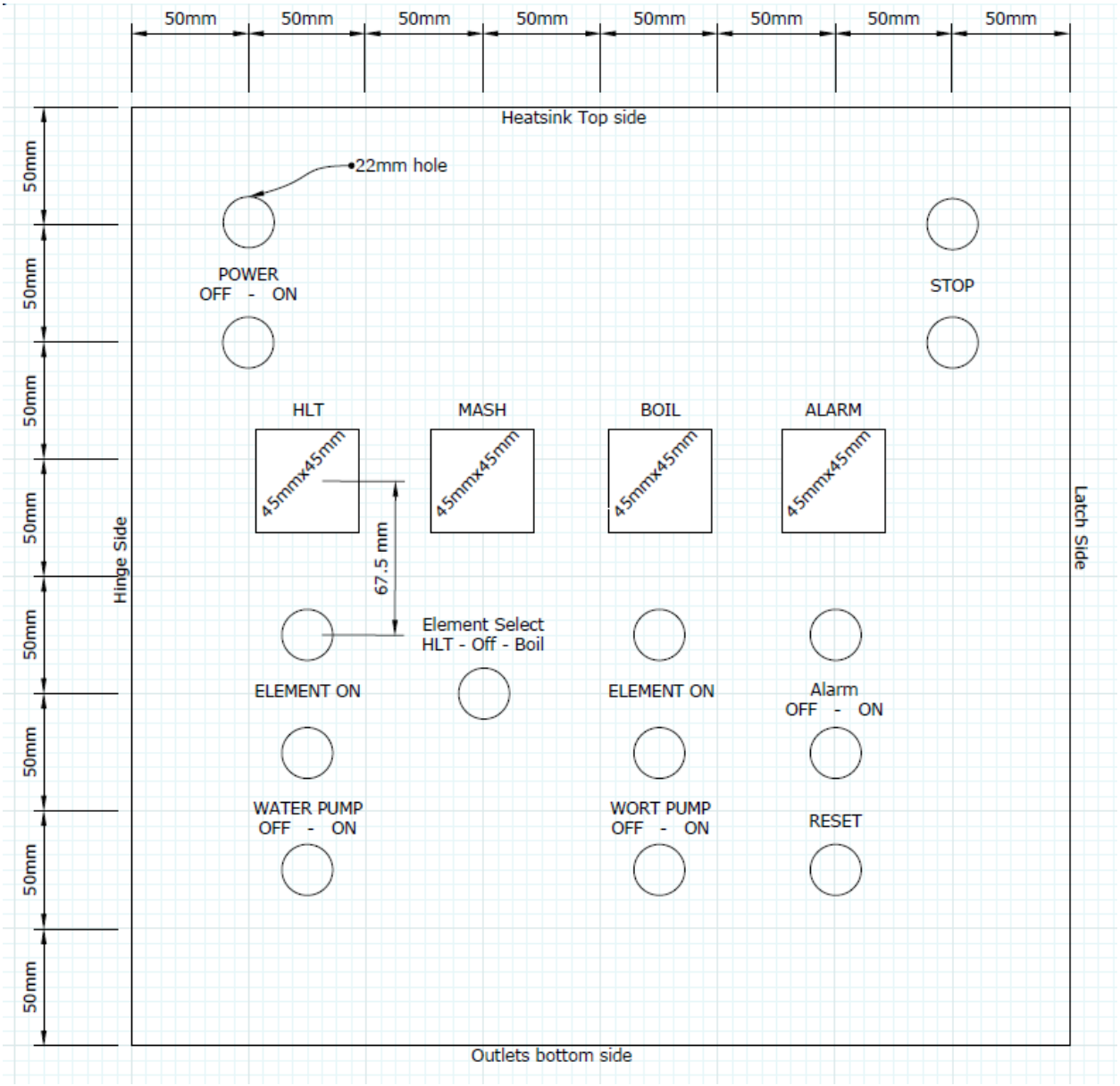
30a BCS Basic DIY Panel Layout

The following is the usual layout used for panels built. The metric measurement is easiest due to the fact that the majority of enclosures (US made or import) are in fact made to metric dimensions such as our standard of 400mm x 400mm for the door. The grid below is broken into 50mm increments.

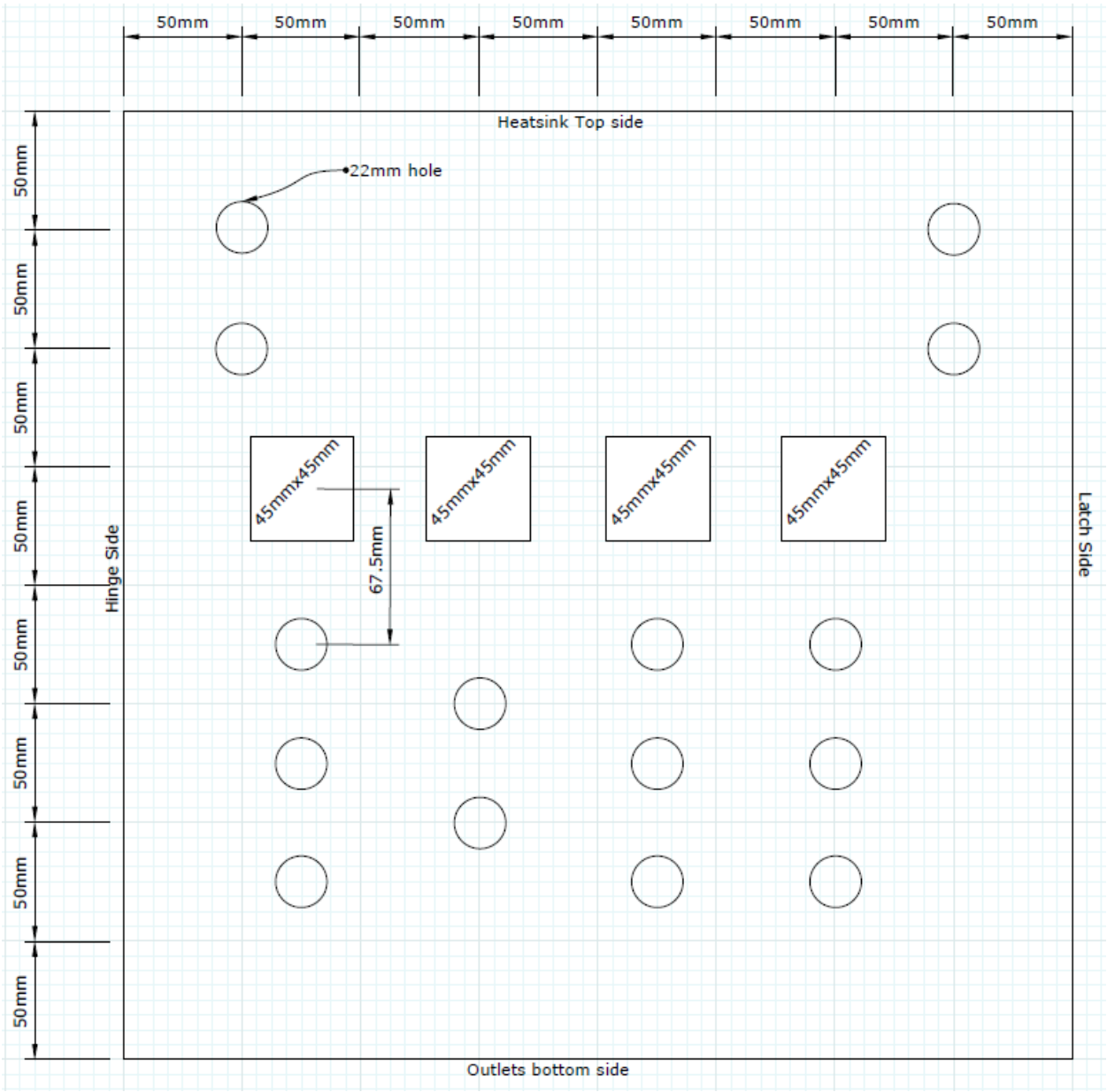




50a BCS Complete DIY Panel Layout



30a PID Panel Layout

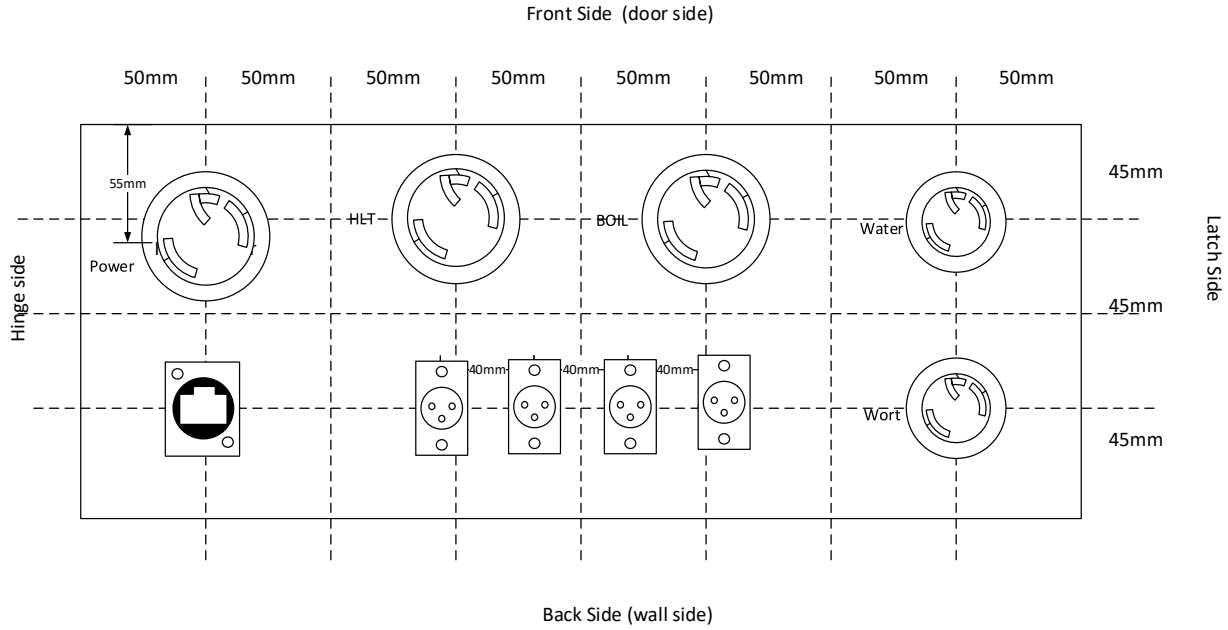


50a PID Panel Layout

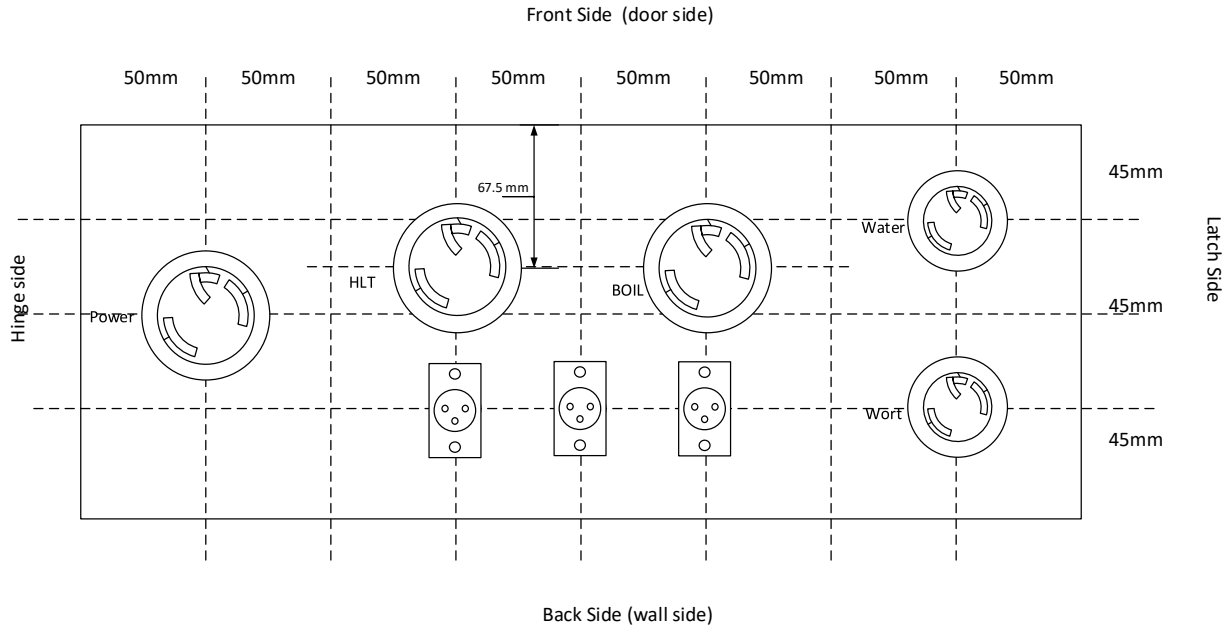
Bottom of Enclosure Layouts

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

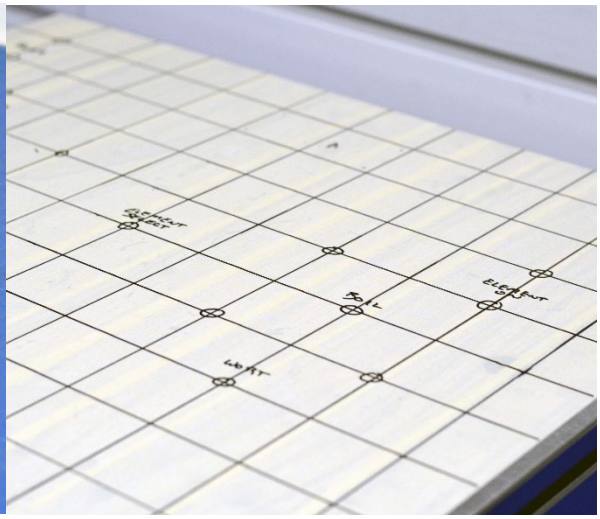


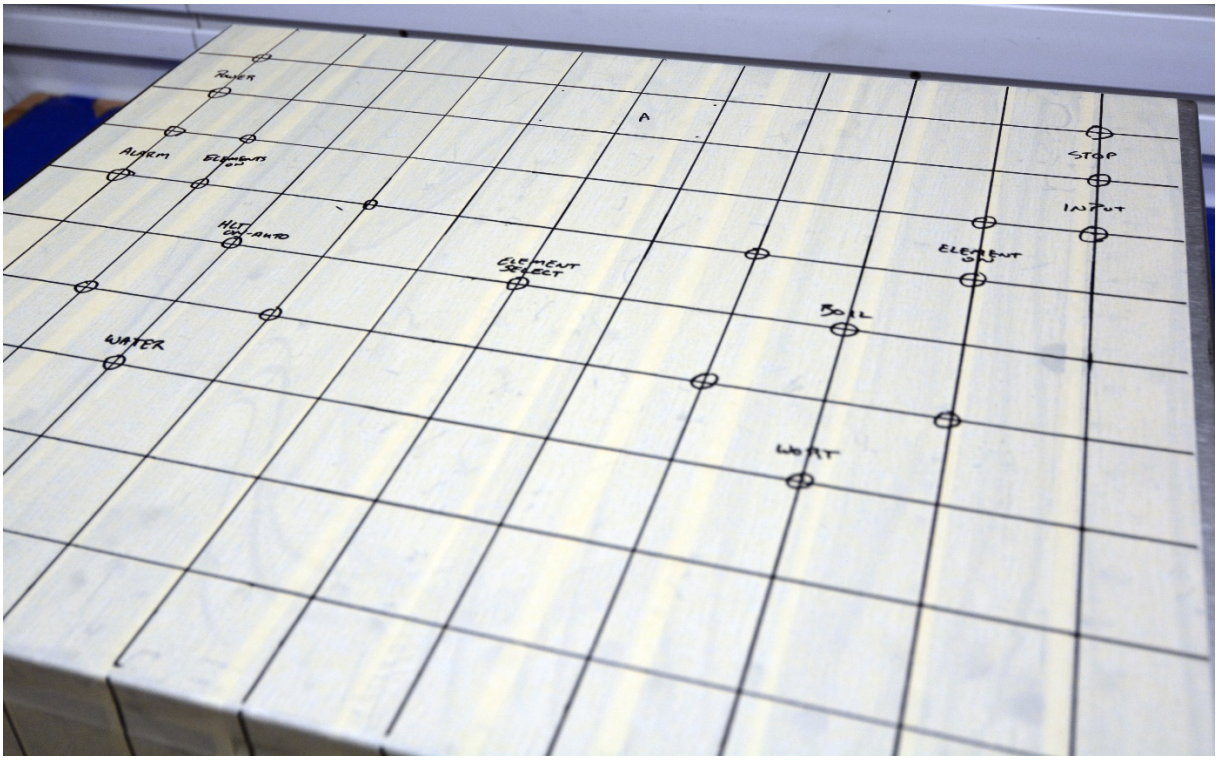
2 element PID Panel bottom layout



Laying out and cutting the holes

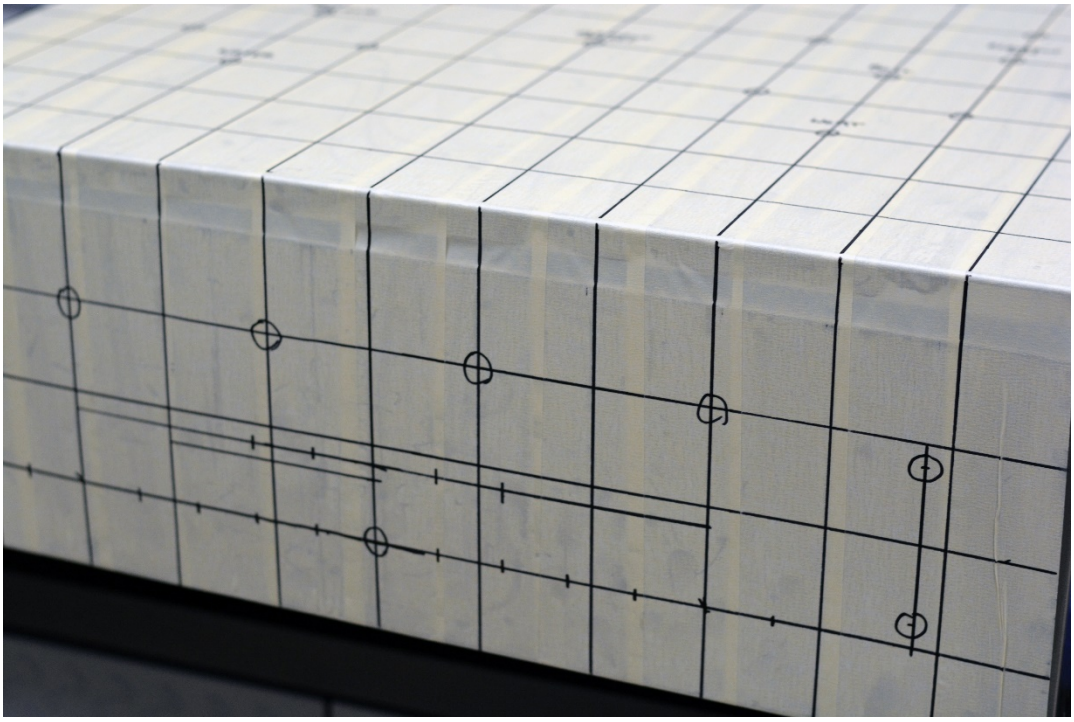
To cut the holes for your panel, you will need: Painters tape, a Sharpie marker, tape measure, speed square and an idea for your layout. The painters tape will allow you to layout your design without imparting any marks on the enclosure itself.





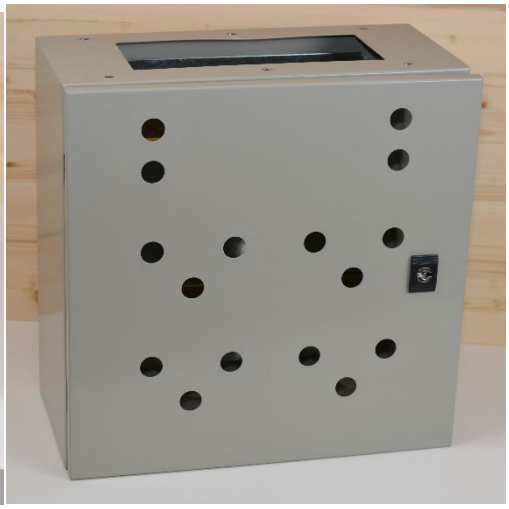
In order to ensure that the heat produced, escapes some place, it is highly recommended that you use an external heat sink. Our drilled and pre-tapped heat sinks have standard dimension, and therefore layouts for easy install.

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).



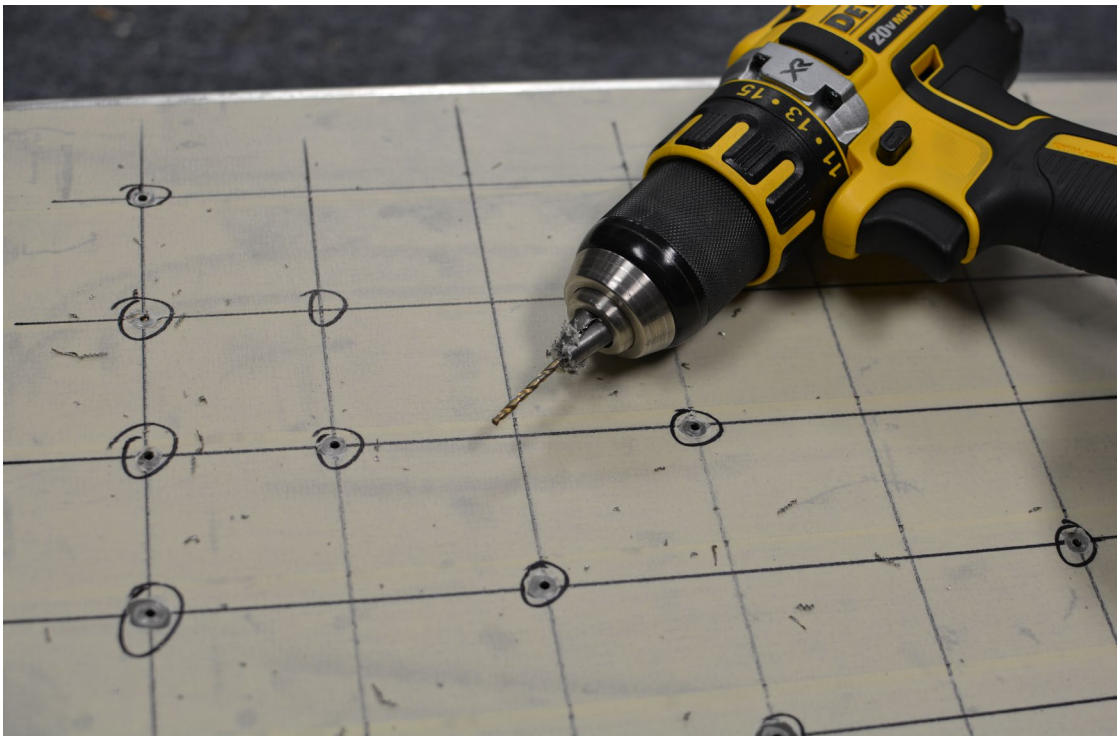
What Size holes are you going to drill?

- 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

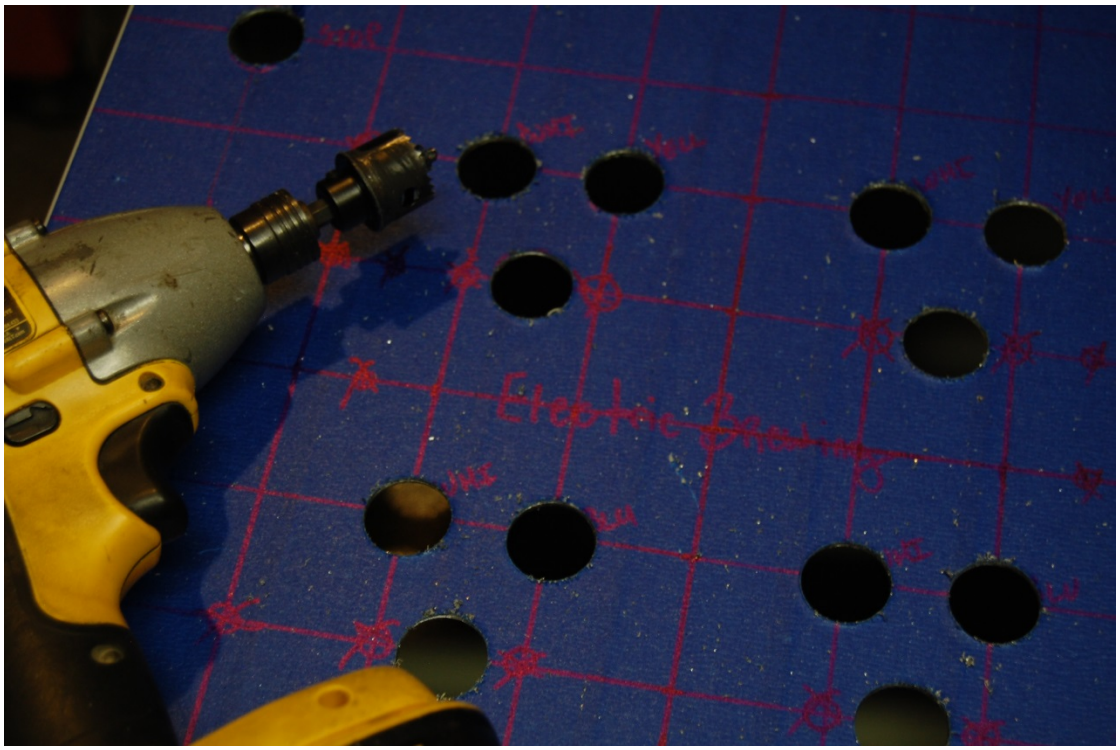


*Layout may differ slightly as we have had a number of minor revisions either by vendors or ourselves.

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.

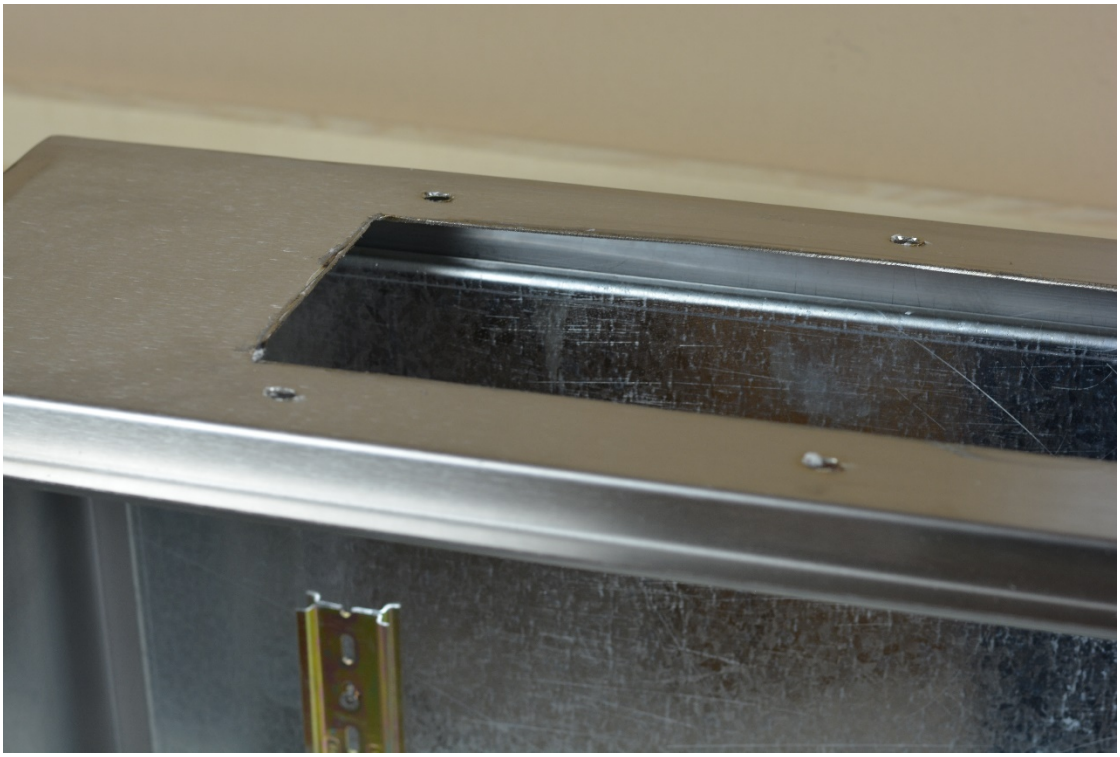


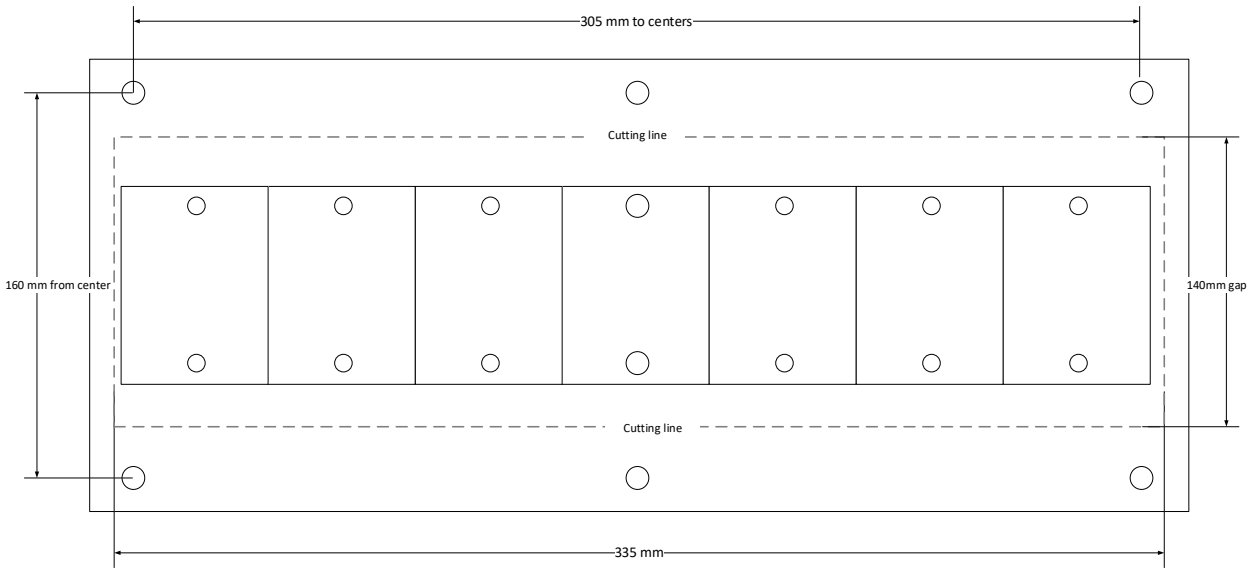
Use your 7/8" hole saw, after drilling the pilot holes.



The Heatsink

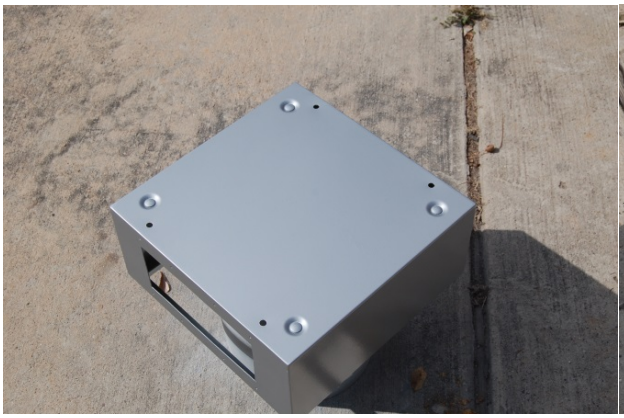
To cut the top out, for the quickest results, use an angle grinder. You may also use a rotary tool. It is also important to note that the screw holes for the heat sink are at 0mm, 152.5mm, and 305mm apart running the length of the heat sink, these are then centered, and placed at 20 mm from the back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





Painting

Once you are done cutting and drilling, do a dry fit of all your hardware to insure it fits as desired. 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 phases; while this book combines door and enclosure wiring, each aspect can be considered a separate phase. The reason for combining door and enclosure layouts going forward is so that you may see the grand plan as you build. Complete wiring layouts will be available late Q2 2018.

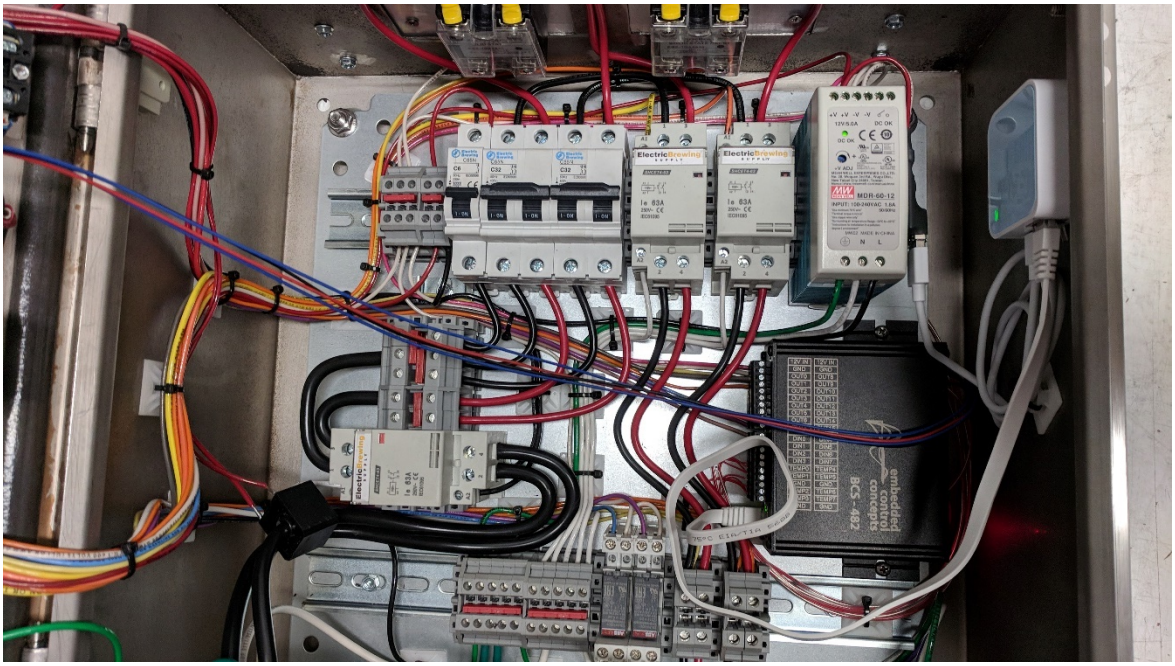
As you begin to wire your panel, you can consider your build in 6 stages:

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 sub panel from the enclosure, keeping the panel out of the box. Wire this panel 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 (+/- input side) wires towards the back of the enclosure. This will make for easier access later. Once these wires are in, install now wired sub panel. Once the sub panel 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 to neutral or ground when 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. You can see this also as a voltage reading across the 2 hot legs of approximately 40 to 60 volts.

We follow this process every day and recommend it for yourself as it will keep the project more manageable for yourself. While we do scrap wire, the ease and cleanliness of the product is our goal.

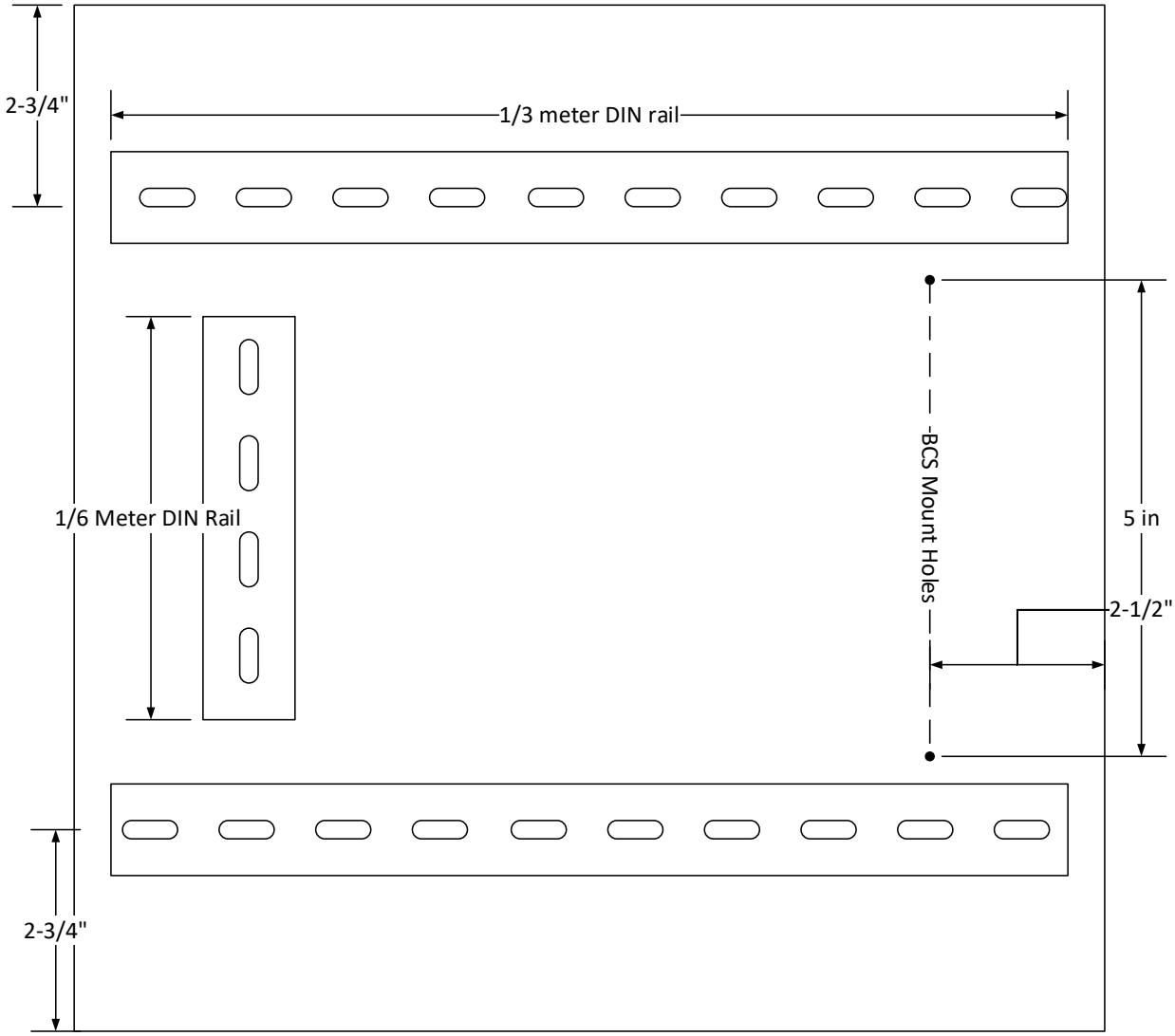
Layout inside wiring

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 if you purchase a basic or deluxe kit; complete kits are all pre-assembled with din. For deluxe and basic, 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-drilling screws or drilling holes and tapping, install your DIN rails on the plate. Keep in mind that there will be a lot of heat produced, so air gaps are a good thing as this allows heat to dissipate.



Because of the rigidity of 10ga wire and the challenge of a good hold at the contactor, we use extra terminal blocks rated for the 2 wires to secure the circuit. 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.

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.



Wiring kit breakdown and explanation

BCS Wiring

Yellow - HLT Elements

-- 18ga – Cut 2 pieces 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 - A 4ft from A1 of first contactor to switch, in 4 element panels you will run 2 wires in the same fashion to each contactor. (1st and 3rd)

Orange - Boil Elements

-- 18ga – Cut 2 pcs 10 ft for element LEDs, remainder to run from BCS to switch and then to SSRs

-- 14ga - A 4ft from A1 of first contactor to switch, in 4 element panels you will run 2 wires in the same fashion to each contactor. (2nd and 4th)

Blue - Water Pump

-- 18ga - Loop from BCS to switch to relay on sub panel

-- 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 direct to relay from BCS

-- 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 beside 1p Breaker and runs to the e-stop

Black

-- 14ga - Daisy chain 110v power on switches, from terminal block to the din outlet, key switch loop

White

-- 14ga - 110v Common

-- 18ga - DC Power(-) Ground

Green

-- Grounding on pumps and enclosure.

PID Wiring

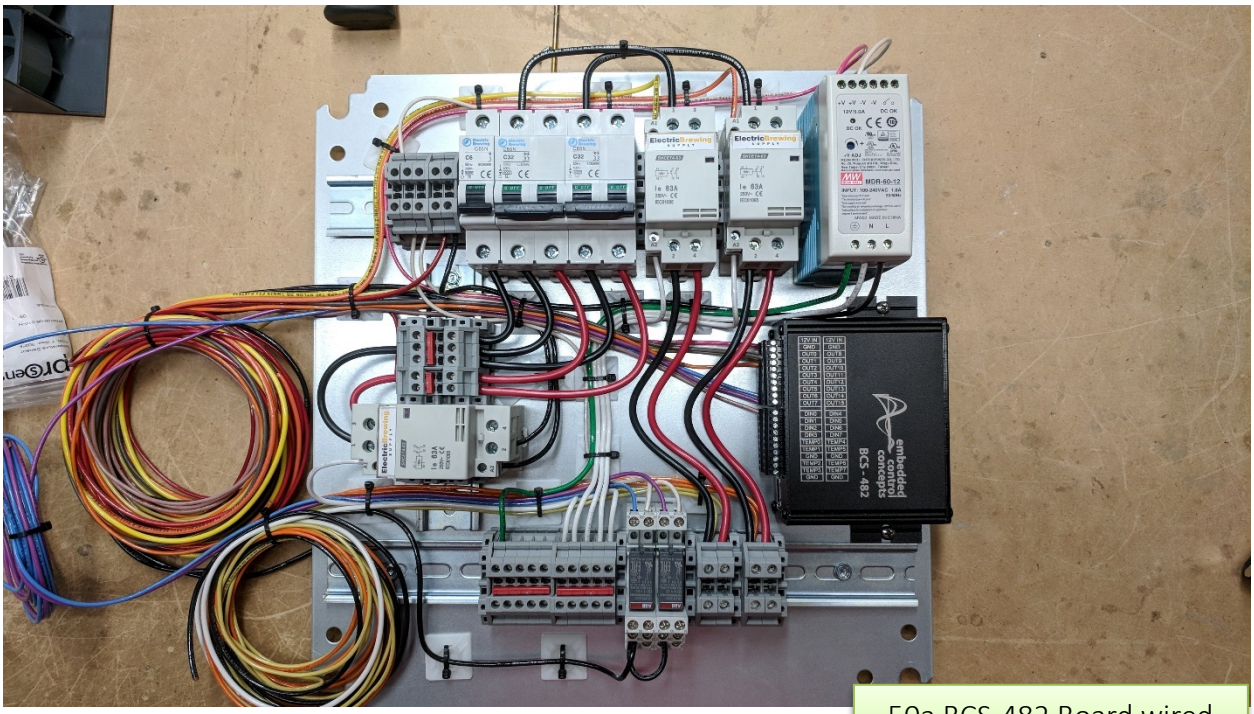
Yellow - HLT Elements
-- 18ga - 2 cuts, 8 ft for element LED output, remainder to run from PID to SSR on heat sink
-- 14ga - 1 cut 4ft from A1 of first contactor to switch. , in 4 element panels you will run 2 wires in the same fashion to each contactor. (1st and 3rd)
Orange - Boil Elements
-- 18ga - 4 cuts, 2x 10 ft for element LEDs, remainder to run from BCS to switch and then to SSRs
-- 14ga - 1 cut 4ft from A1 of second contactor to switch. , in 4 element panels you will run 2 wires in the same fashion to each contactor. (2nd and 4th)
Blue - Water Pump
-- 14ga – Run from pump outlet to switch on door by way of a terminal block on the sub panel.
Purple - Wort Pump
-- 14ga – Run from pump outlet to switch on door by way of a terminal block on the sub panel.
Gray - Alarm output
-- 14ga – Daisy chain from alarm outputs to 2-way switch before buzzer
Scrap 18ga yellow/orange - Start Button
-- 18ga – loop to alarm through push button and back to alarm
Red – Main power led indicator and 110v 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
-- 18ga – SSR (-) connection
-- 14ga – 110v neutral
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. From the main contactor to the terminal blocks feeder 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. As well as power inlet on 30a panels; in 50a the 10ga is used for the neutral supply as well.

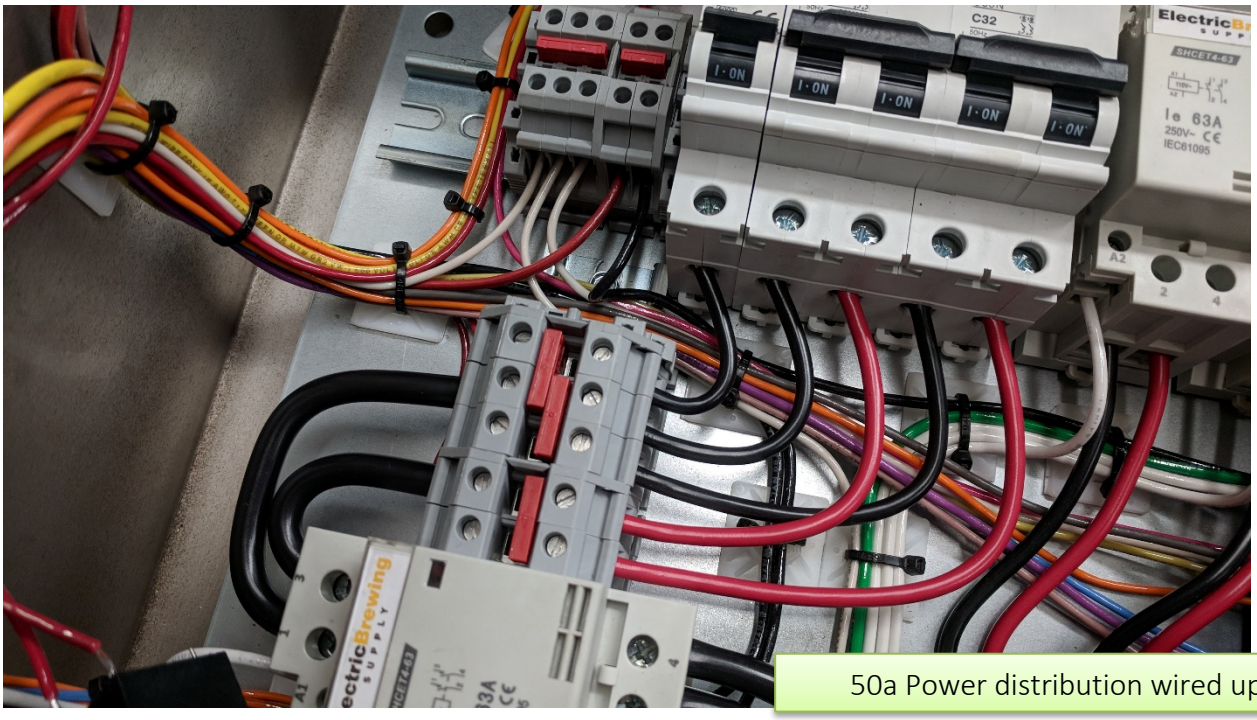
10ga Green is used to ground each element outlet and from the inlet to the inside cluster.



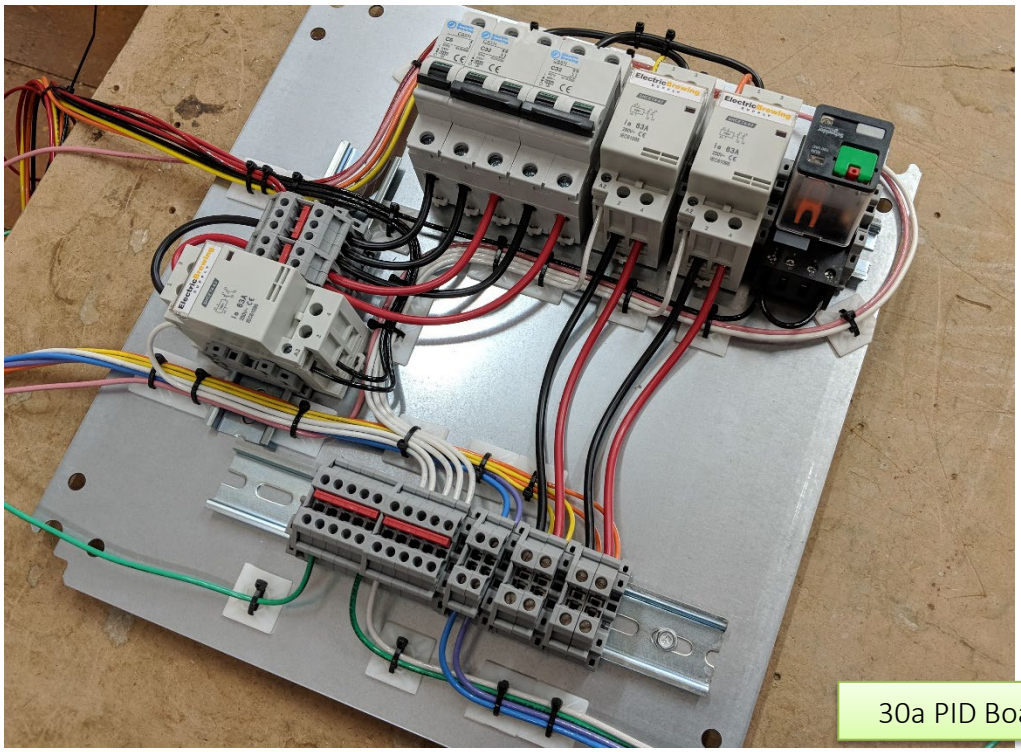
50a BCS-482 Board wired

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.



50a Power distribution wired up



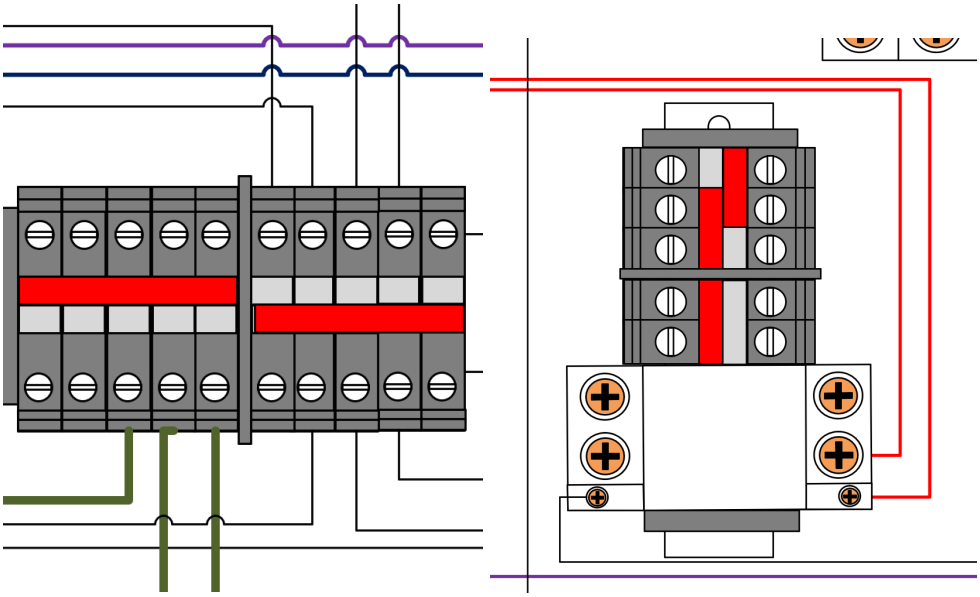
30a PID Board wired

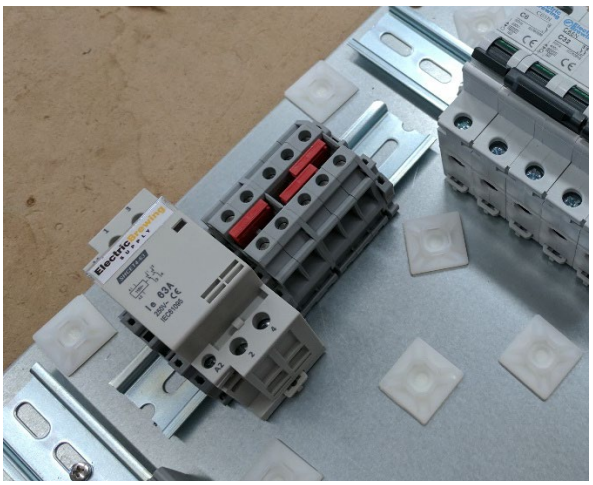
** Bottom right 2 terminal blocks (blue and purple wires) are for the 2 pump wires to the door. From these two blocks we connect to the outlets.

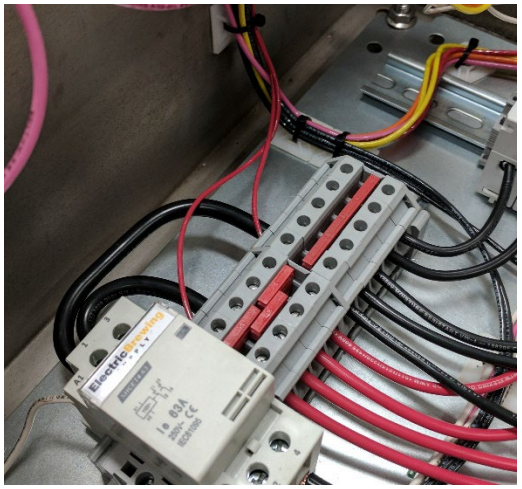
DIN Terminal layout tips

All our panels today ship using Pheonix Contact terminal blocks that use push in jumpers rather than common screw solutions. This solution is faster, but is also more secure and reliable. We've done our best to mimic our placements, but realize that these are recommendations and open to modification. Be sure to put terminal end covers on exposed ends of the blocks.

Important too note: There are 2 types of blocks in your shipment, 3 for 50a panels. There are UT4s, UT6, and UT10. They are stamped on the side. UT4s are what comprise of groupings of 5 for neutral and ground, as well as 2 and 3 for the main power bus (UT10 for 50a). The UT6 is the terminal that holds the element's 10ga along with the 18ga indicator light wire. For PID we also include 2 extra UT4s to hold pump wire down.

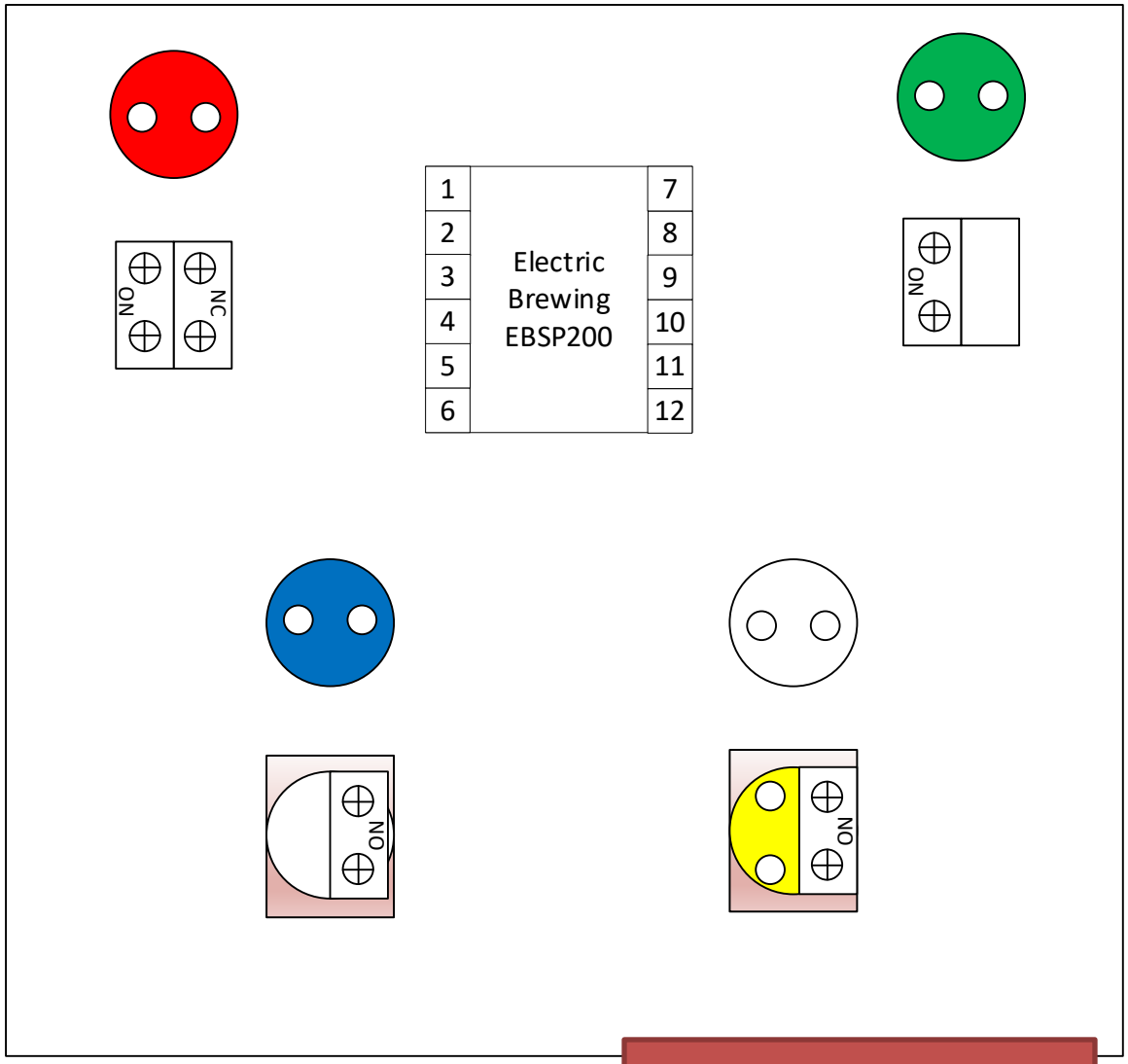






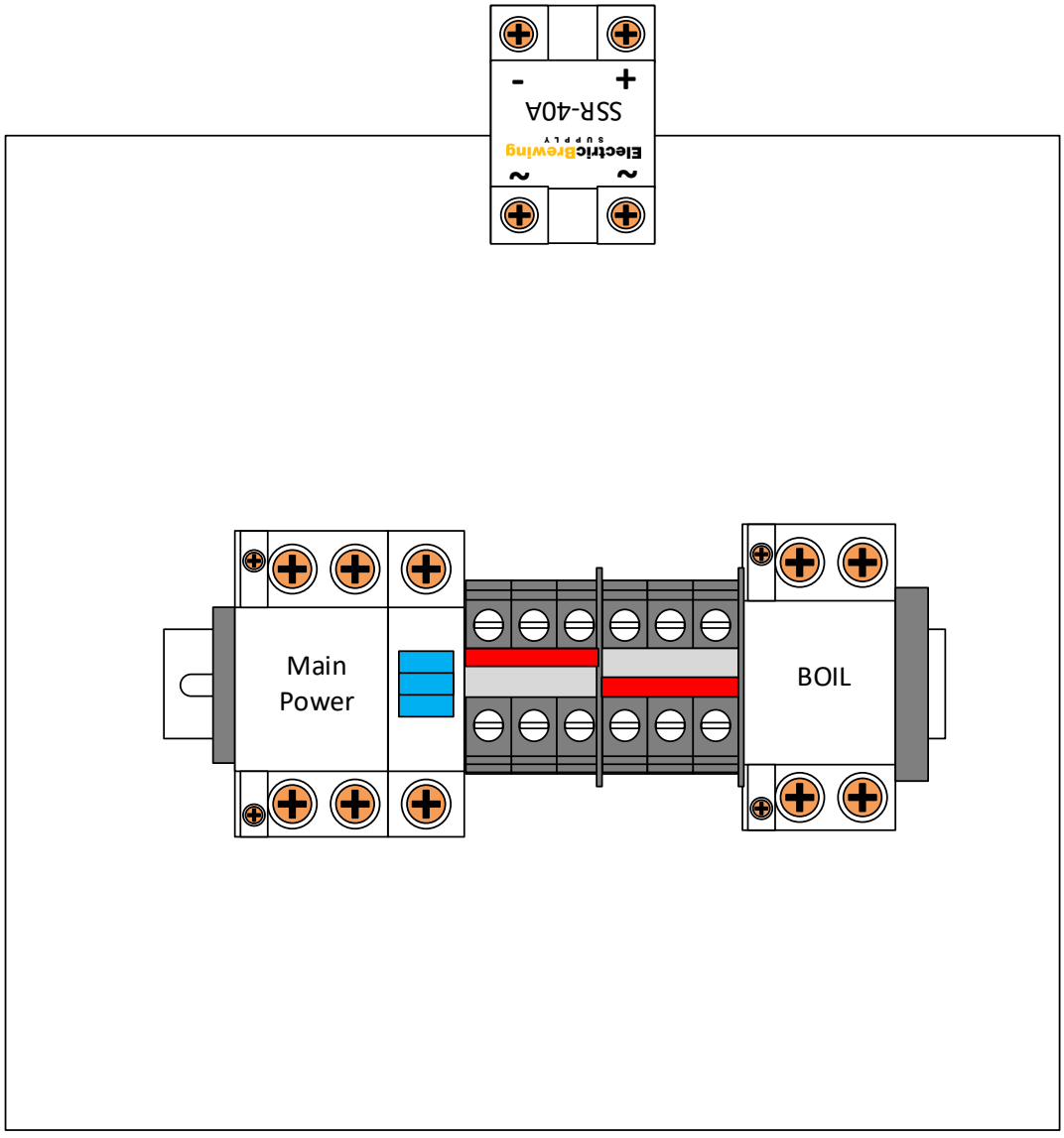
BIAB Build

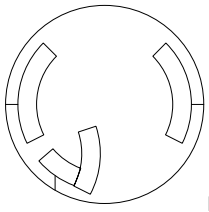
BIAB Door Back Side



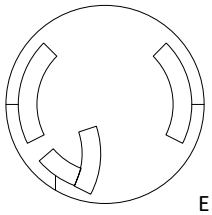
Important NOTE:
Remove the NC Block from the back of your yellow switch after you mount it.

BIAB Sub Panel Layout – w/ SSR

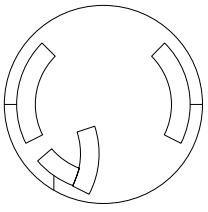




Power

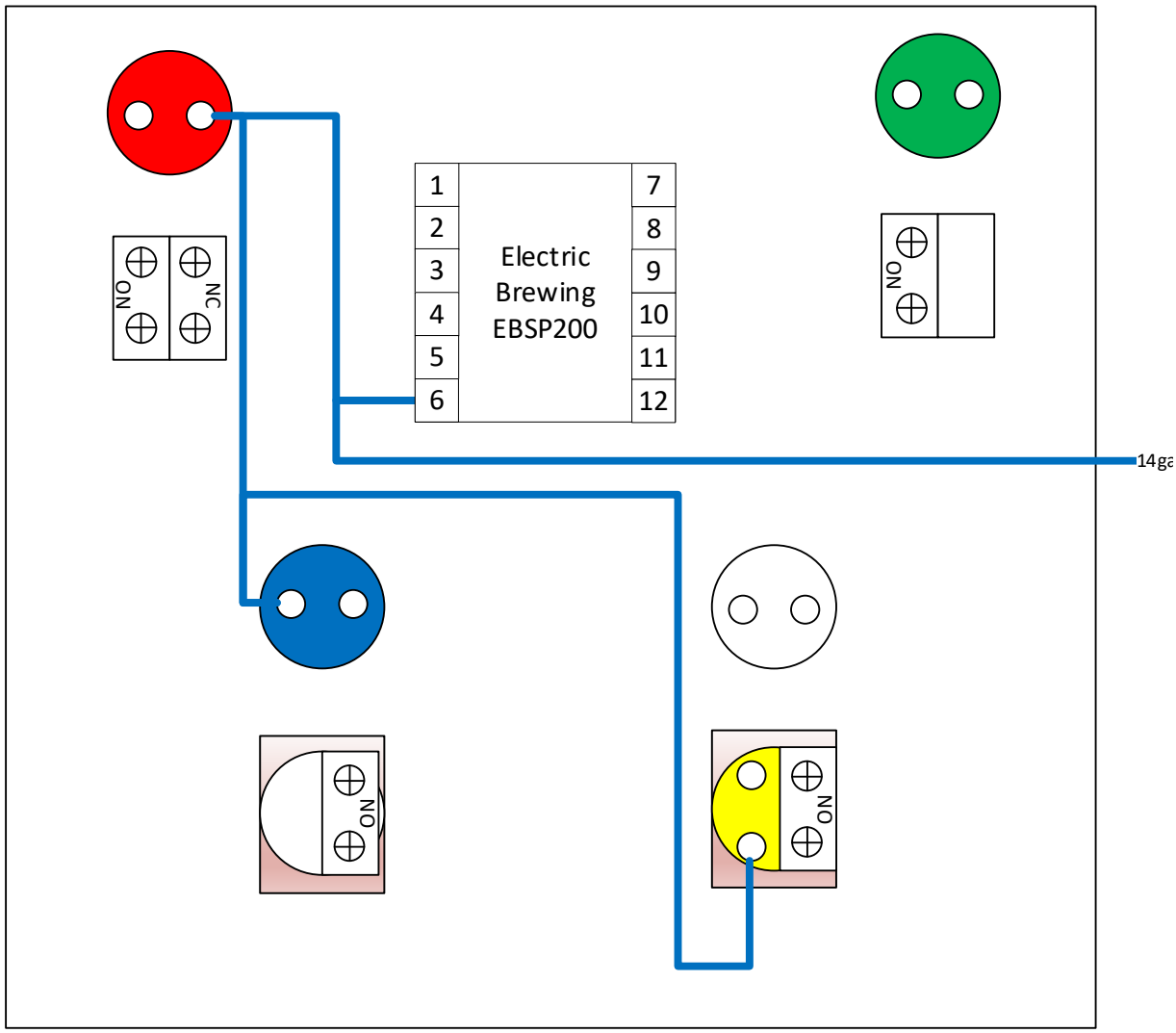


Element

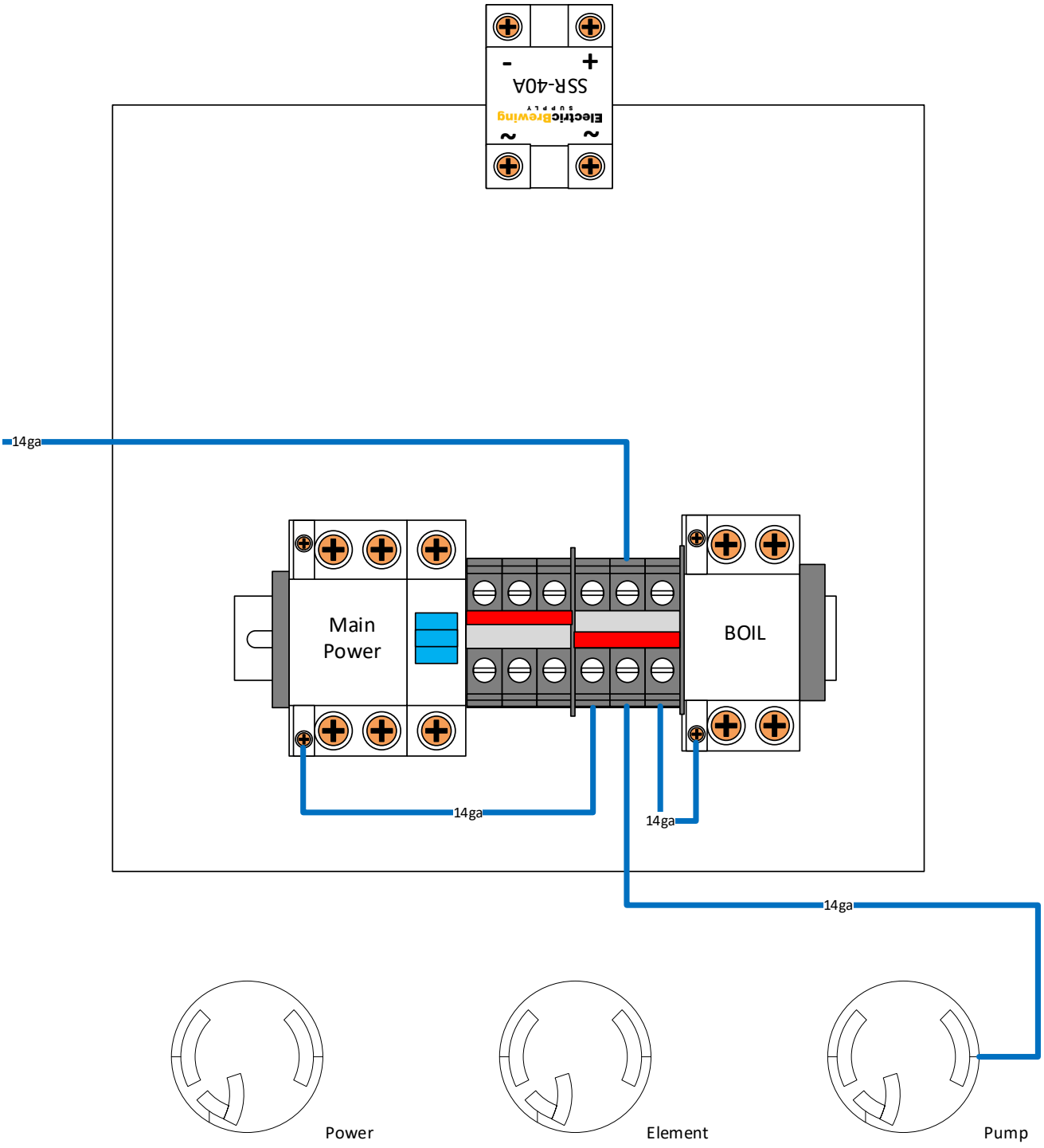


Pump

BIAB Common Door side (white 14ga wire)

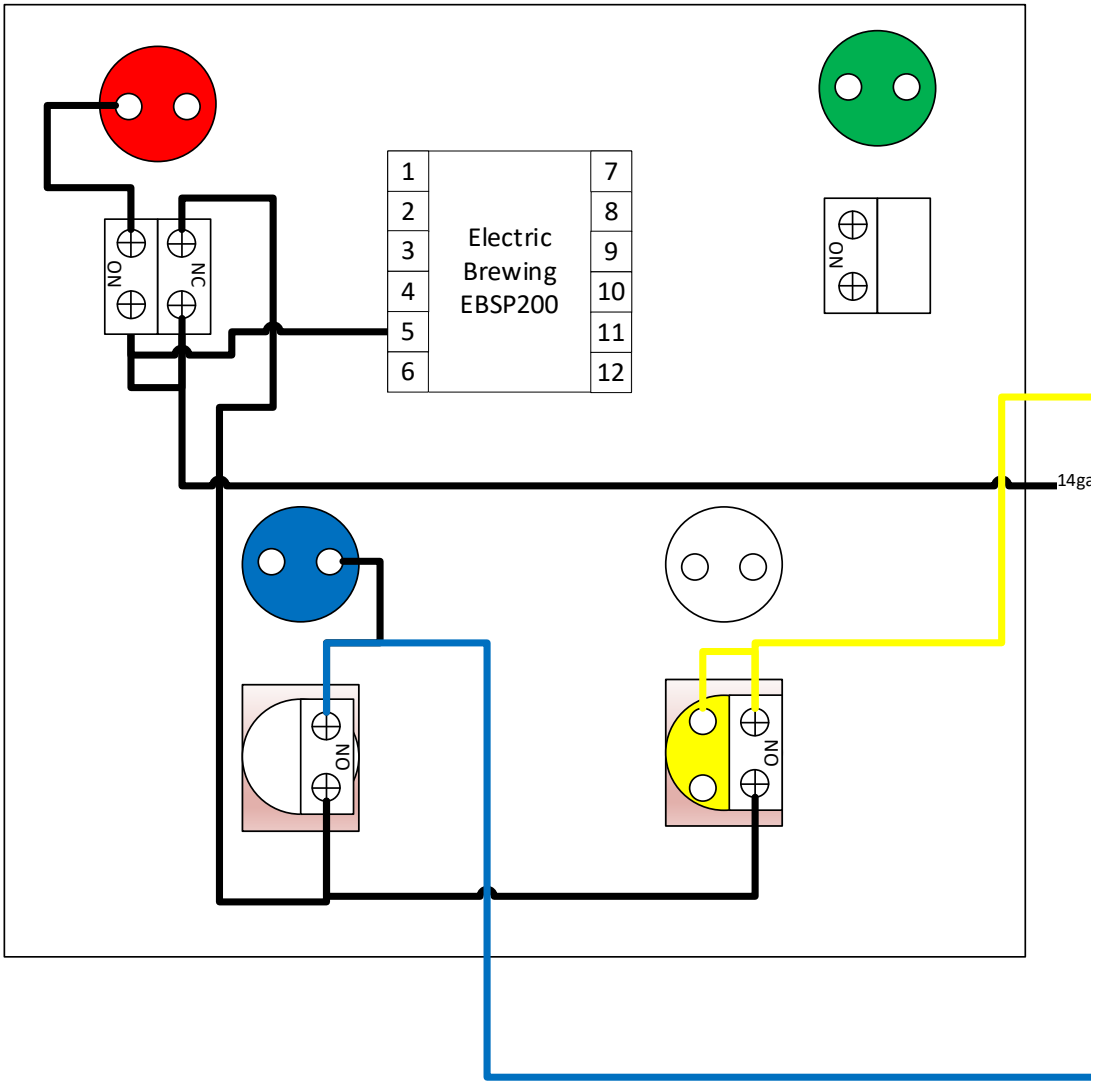


BIAB Common sub panel side (white 14ga wire)

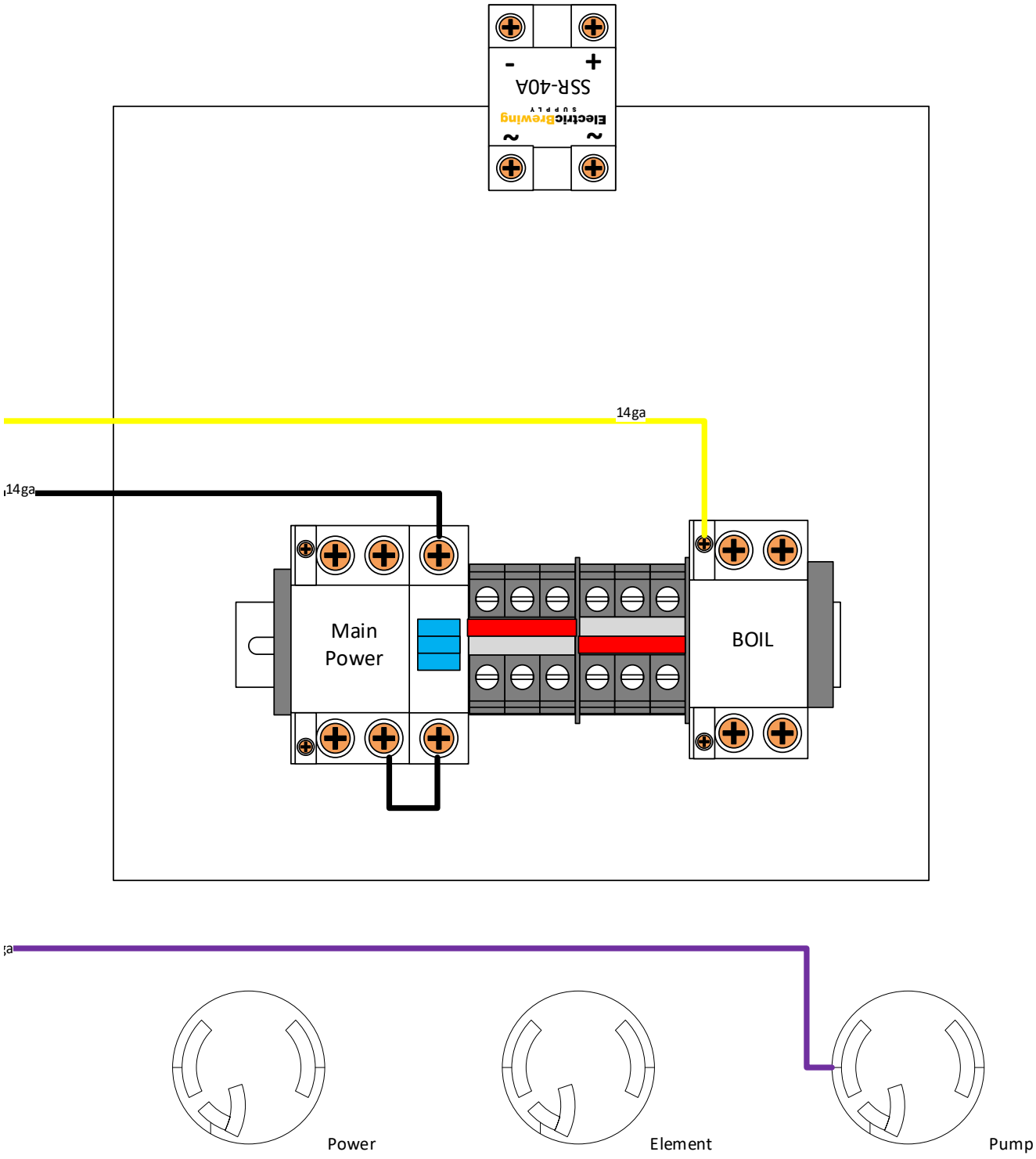


BIAB 110v Hot Door side (14ga wires)

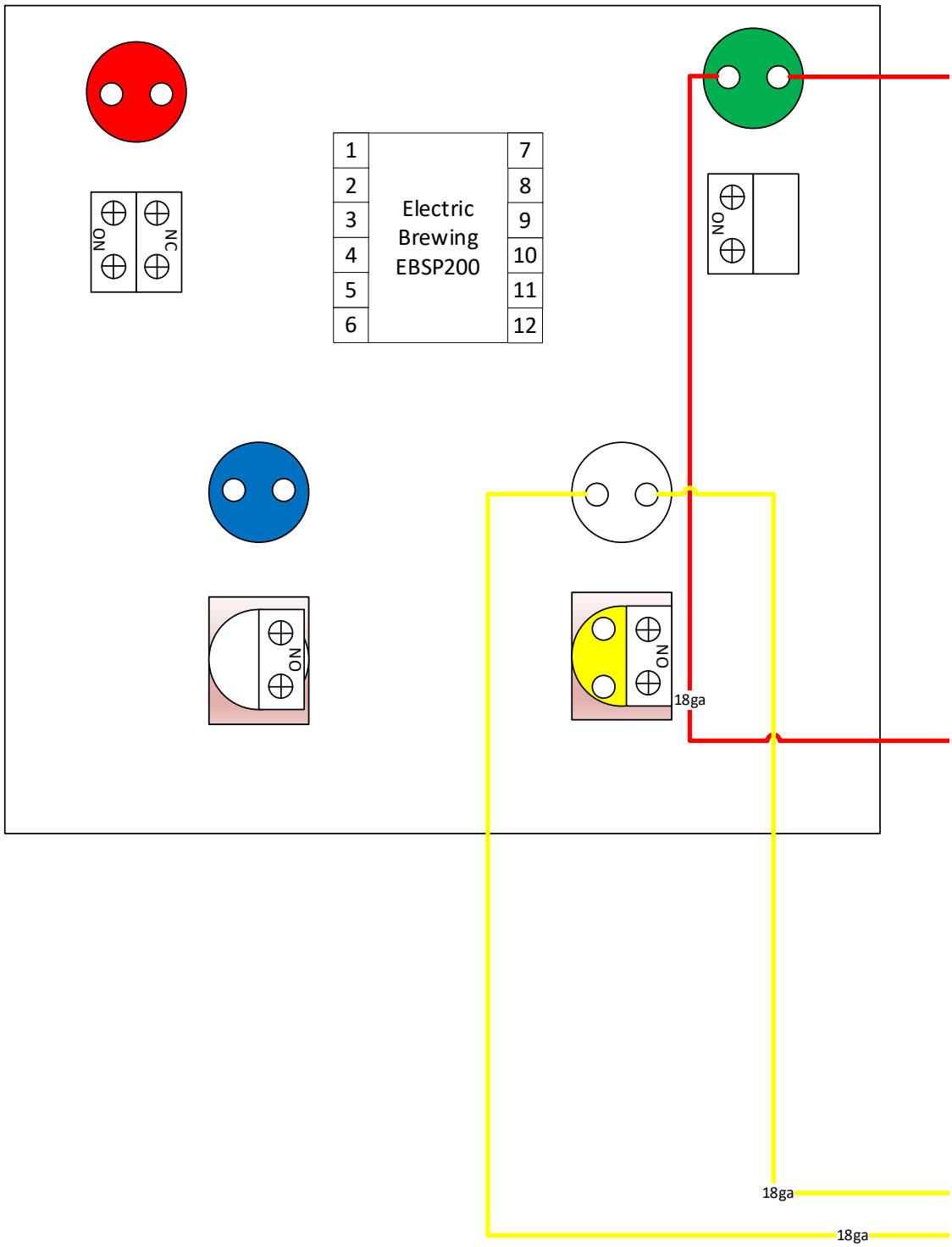
Use blue for the pump side and yellow for the element contactor. Black from the e-stop and red from the breaker.


1
2
3
4
5
6
Electric
Brewing
EBSP200
7
8
9
10
11
12
NO
NC
NO
NO
NO
14ga

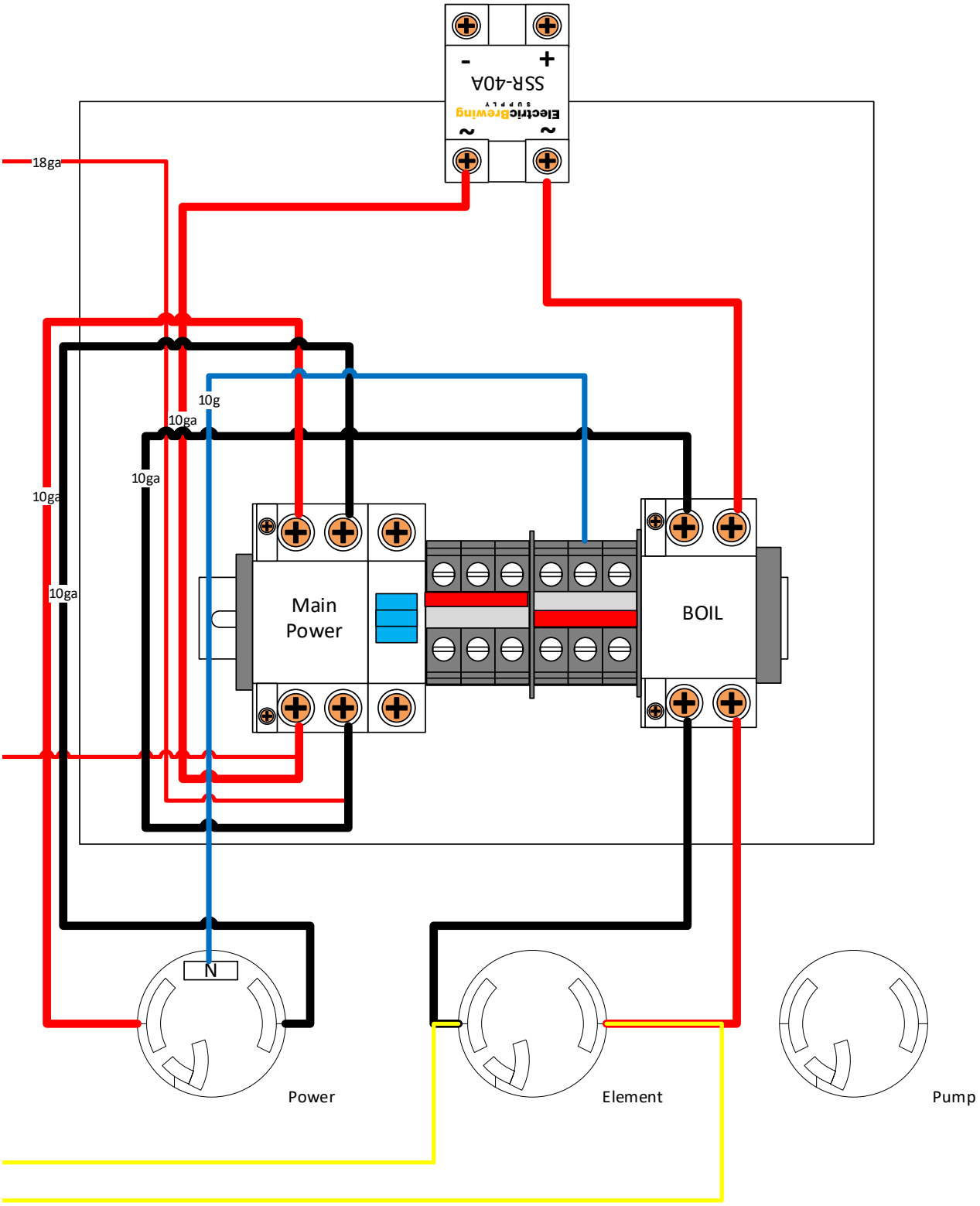
BIAB 110v hot sub panel side (white 14ga wire)



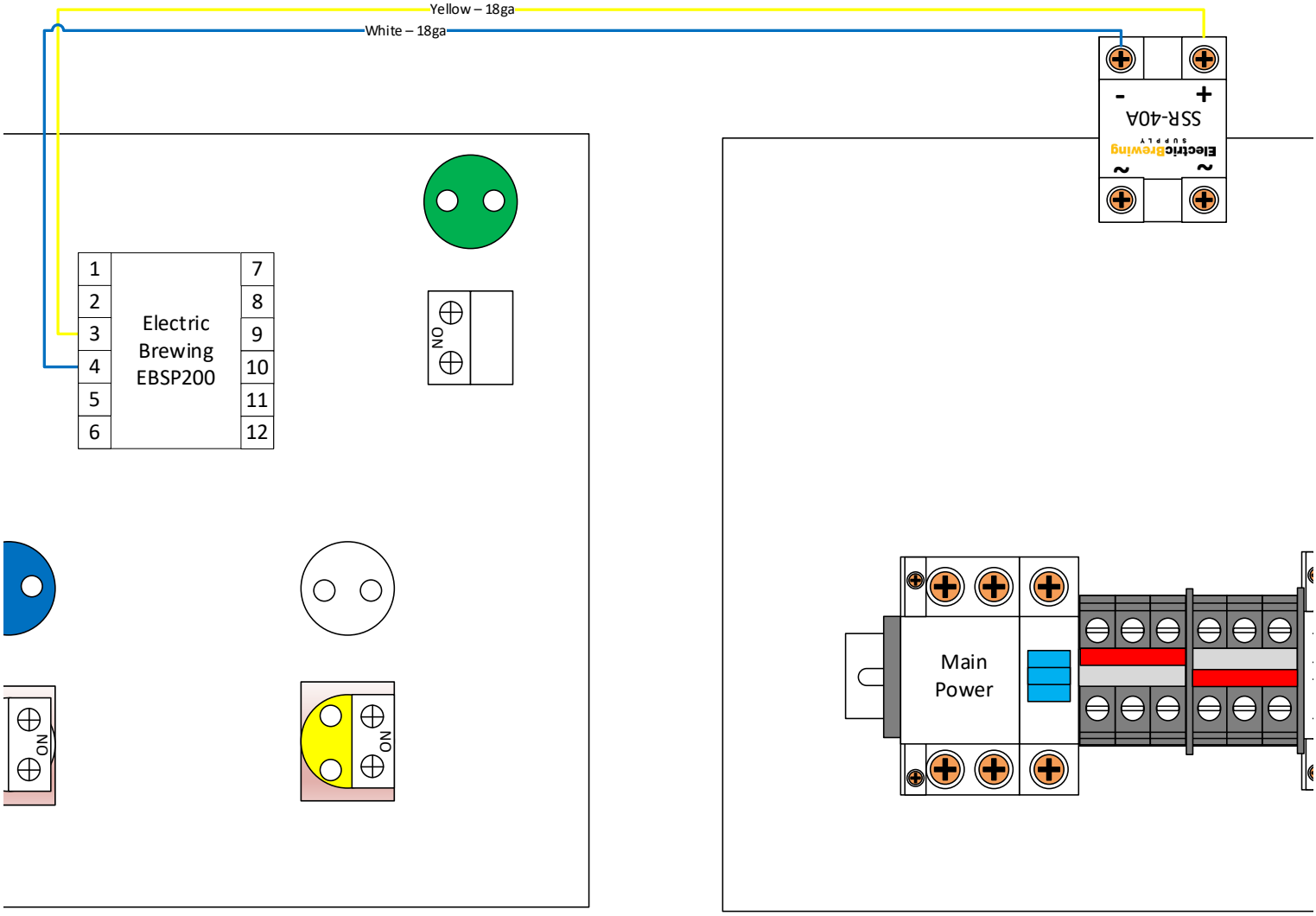
BIAB 220v Door side



BIAB 220v Sub panel side

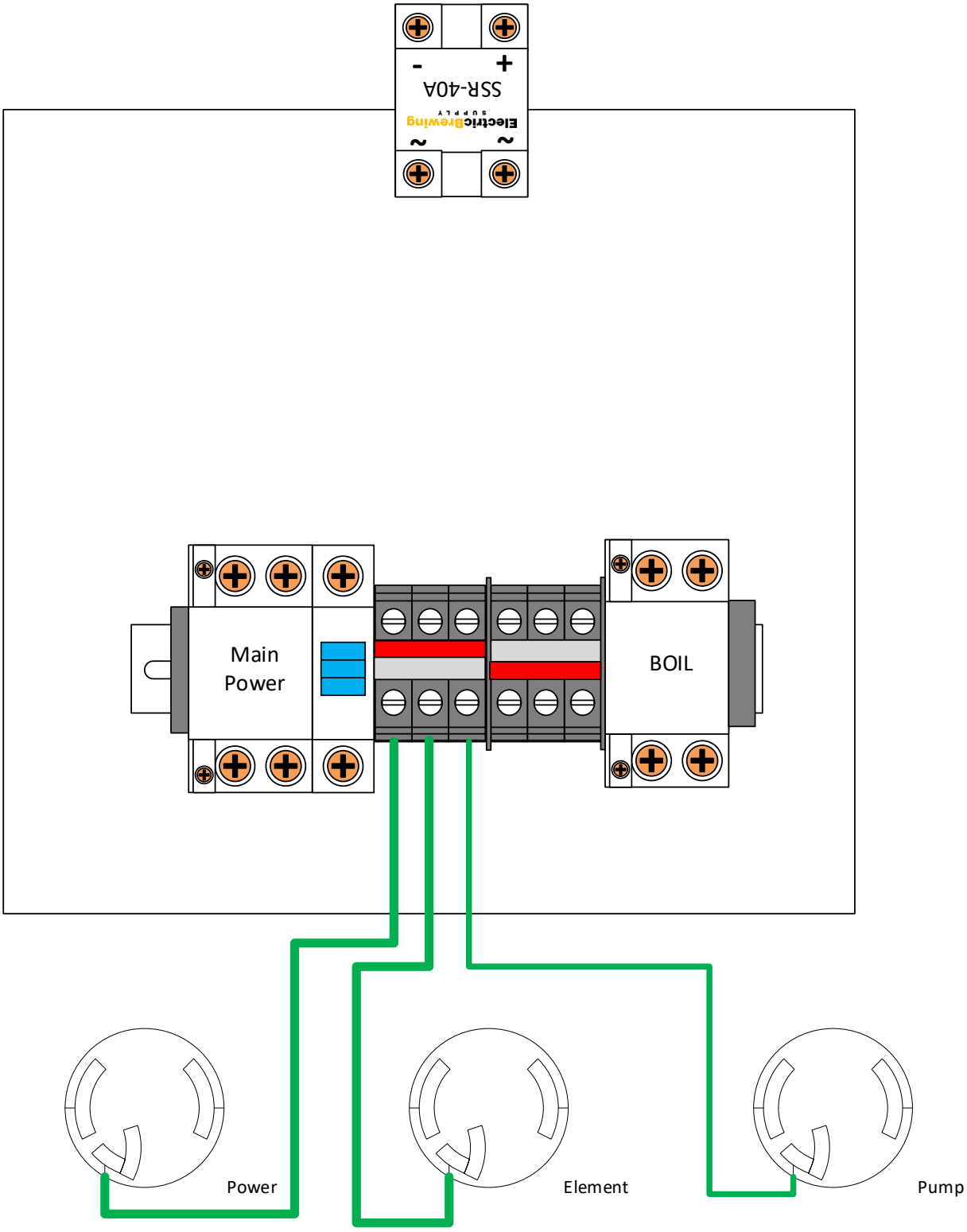


BIAB SSR Control circuit



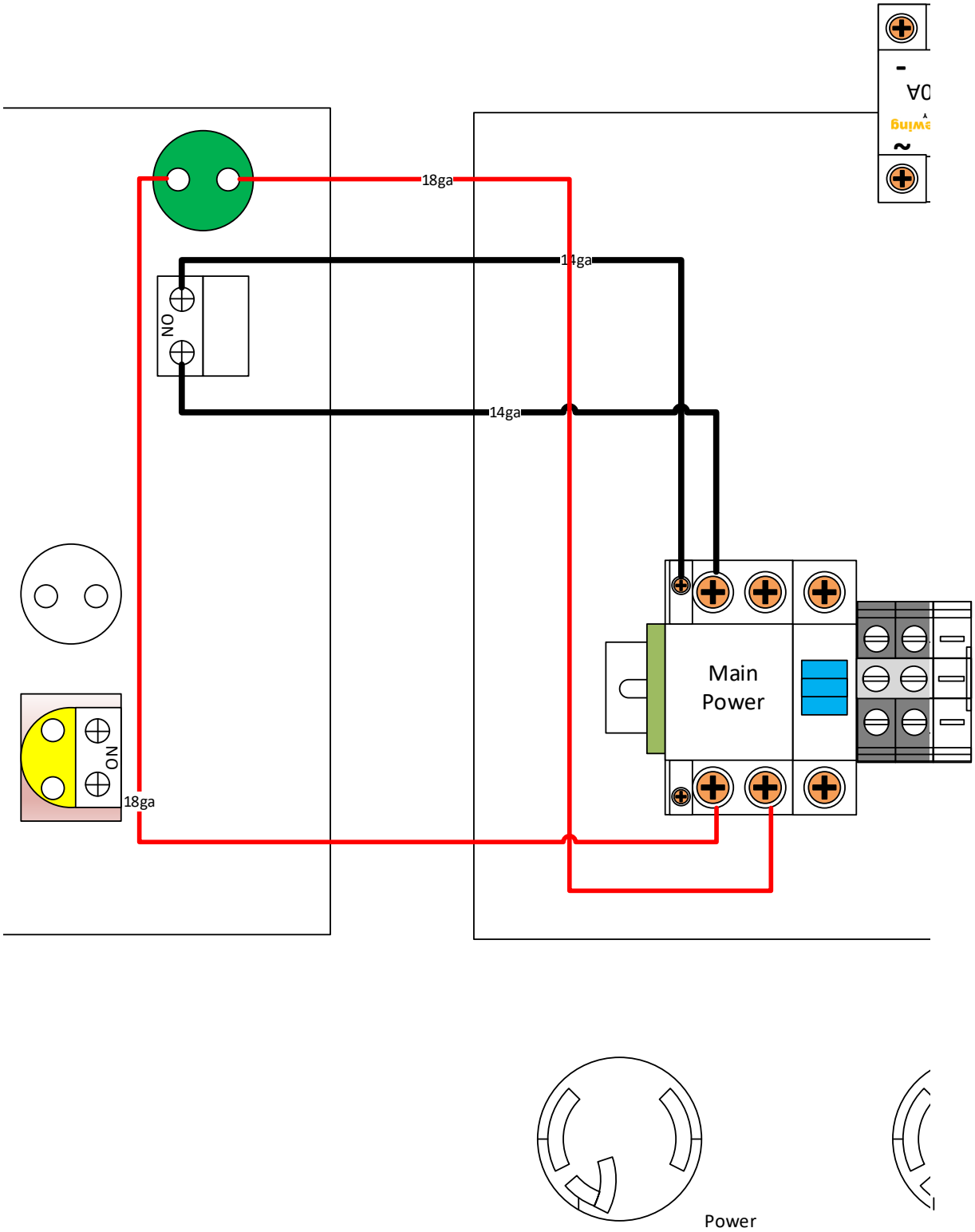
BIAB Ground Wires

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

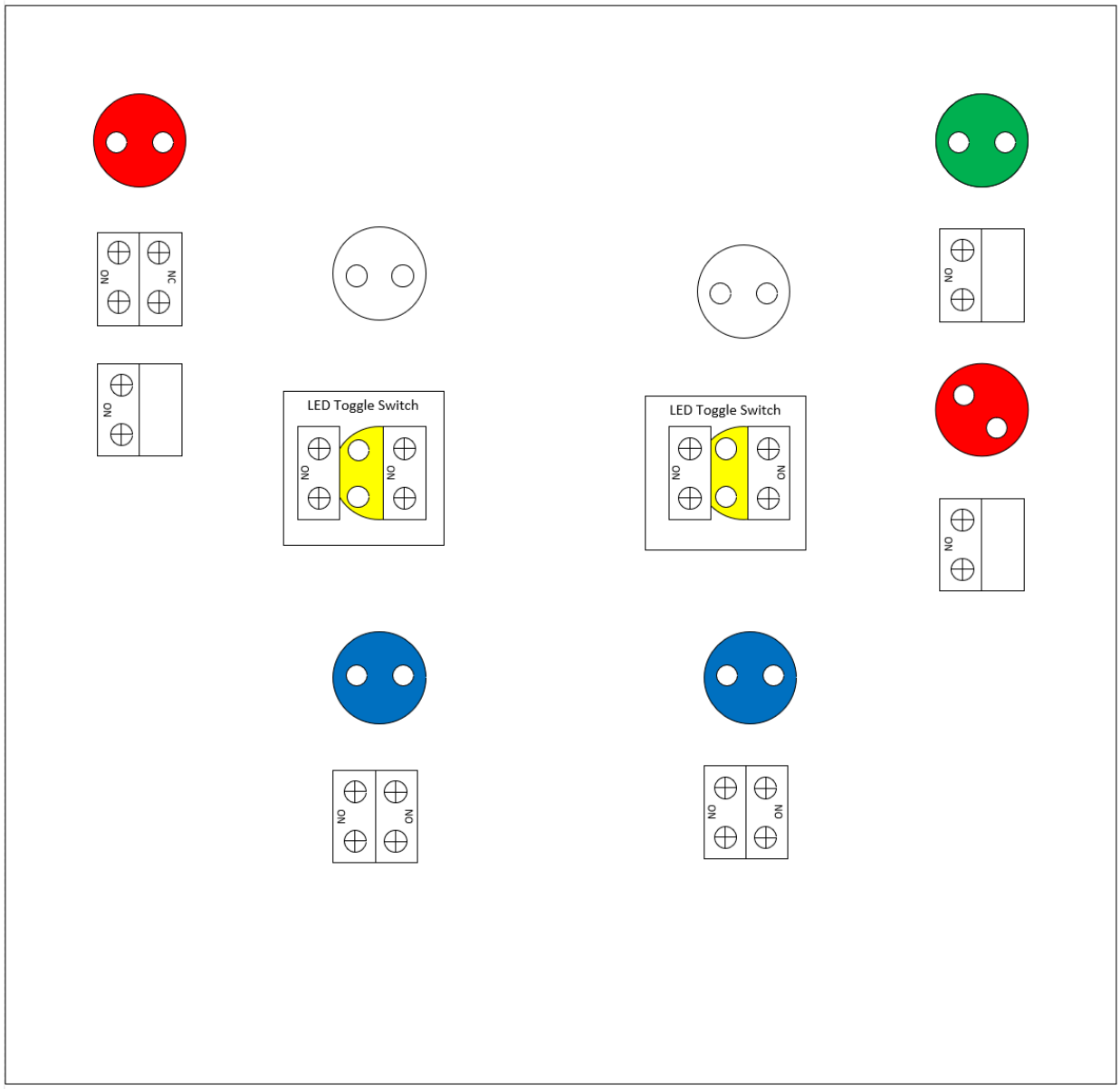


BIAB Main Power

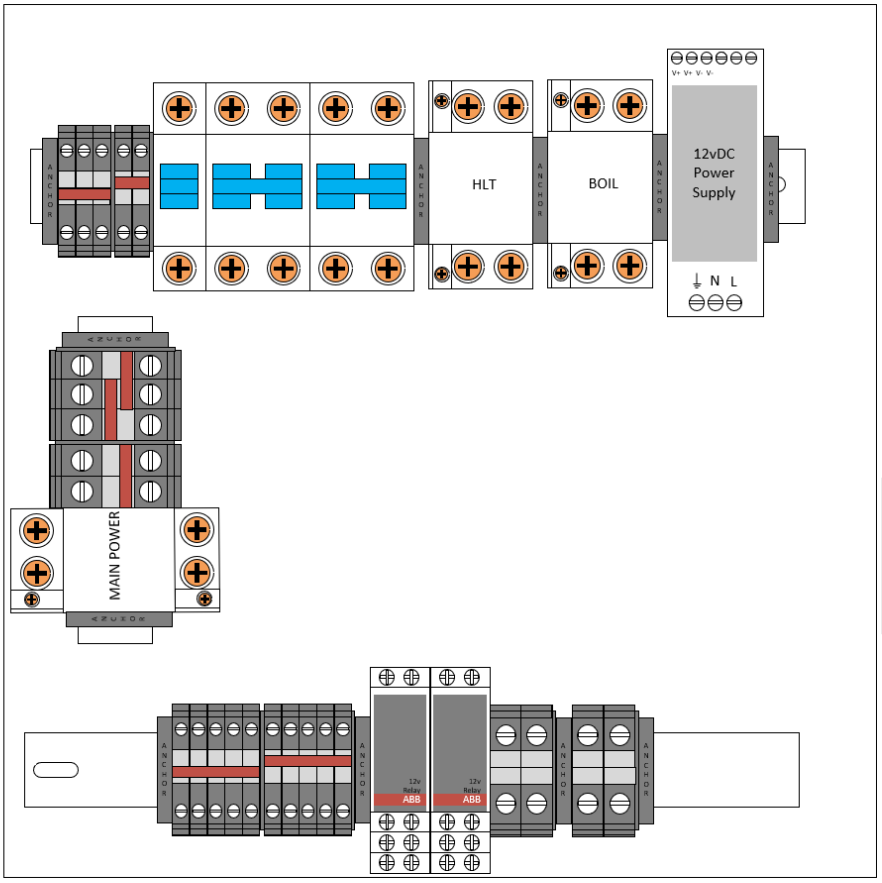
Use approximately 4ft loop from Main contactor pins to the key switch, 18ga red wire is approx. 4 ft looped from the pins.



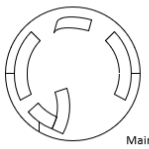
50a BCS Control Door (2018)

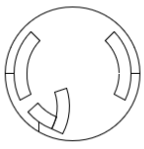


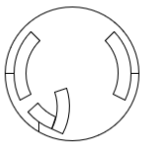
BCS Inside Sub Panel

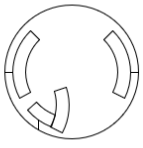


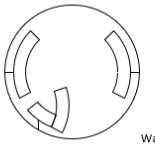
12v (+) In	12v (+) In
12v (-)	12v (-)
OUT0	OUT8
OUT1	OUT9
OUT2	OUT10
OUT3	OUT11
OUT4	OUT12
OUT5	OUT13
OUT6	OUT14
OUT7	OUT15
DIN0	DIN4
DIN1	DIN5
DIN2	DIN6
DIN3	DIN7
TEMP0	TEMP4
TEMP1	TEMP5
GND	GND
TEMP2	TEMP6
TEMP3	TEMP7
GND	GND
Cat 5	


Main Power


HLT

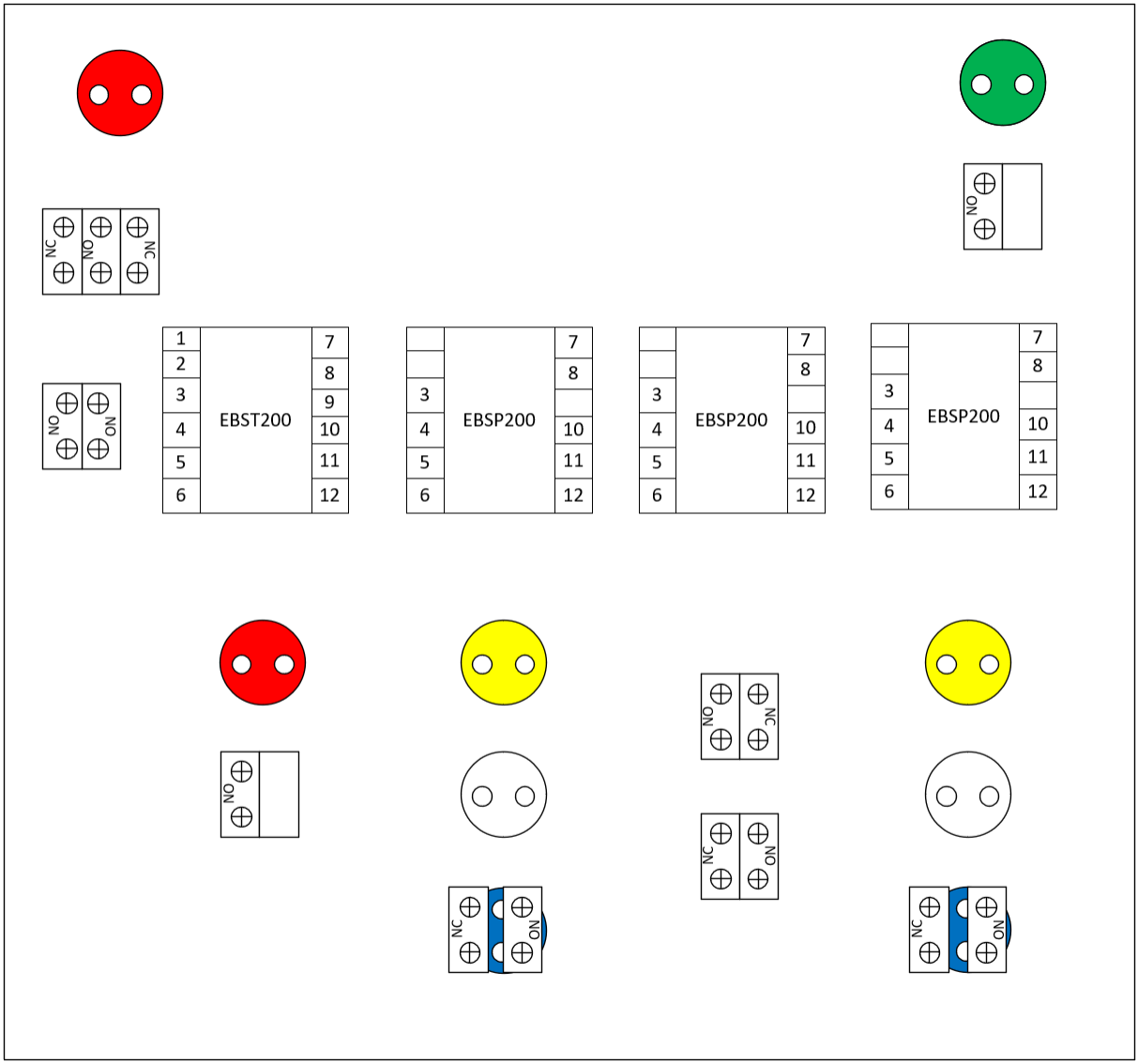

Boil


Wort

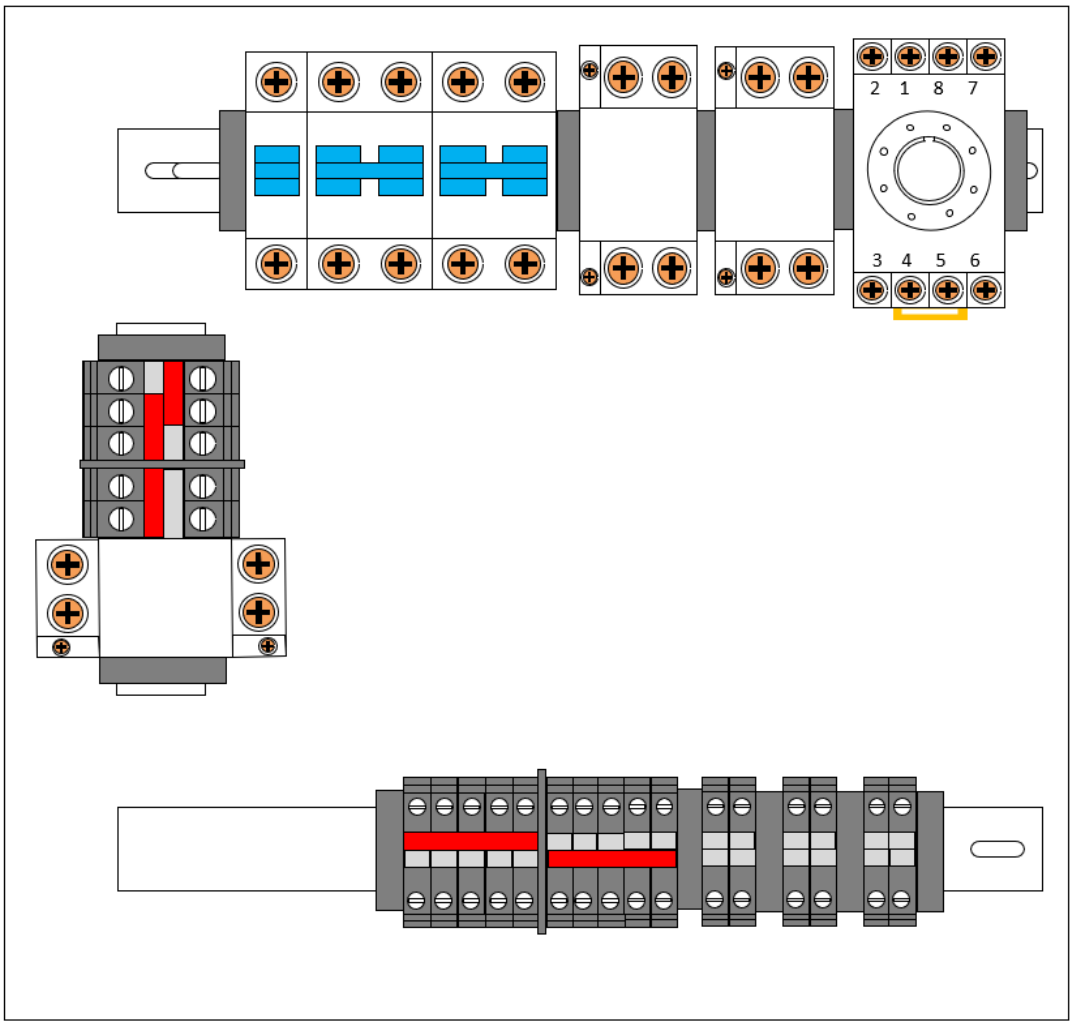

Water

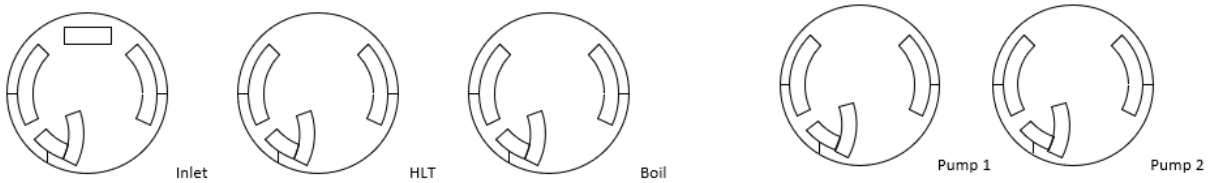
50a PID Door Layout

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

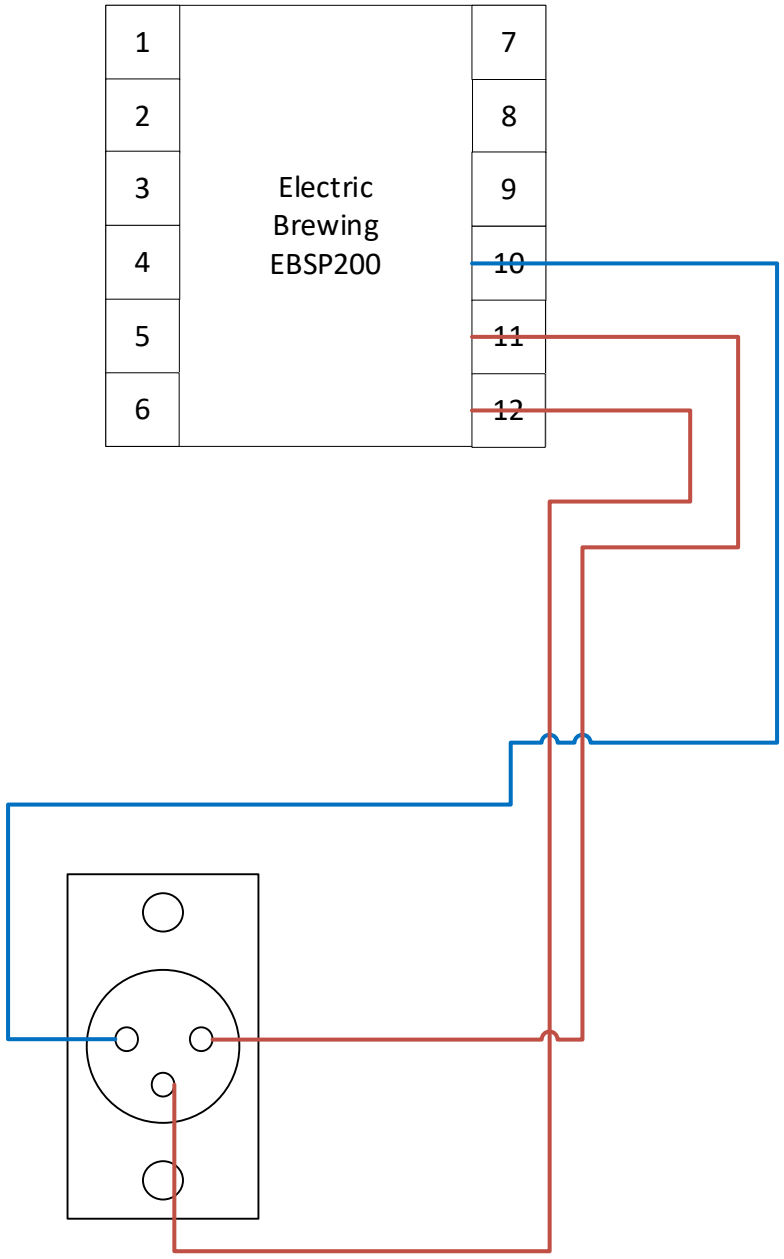


PID Inside Sub Panel





PID Temp Probe Wiring



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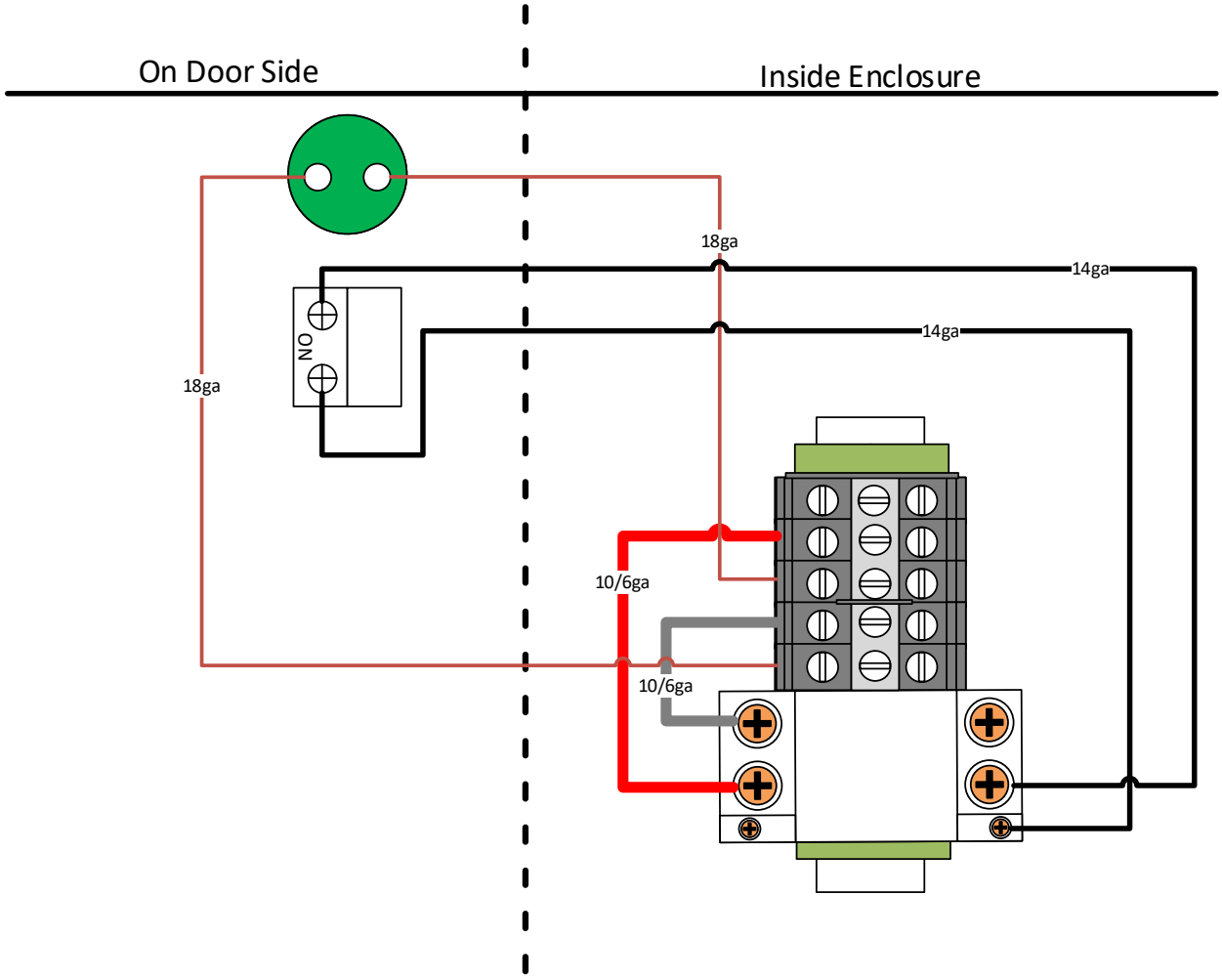
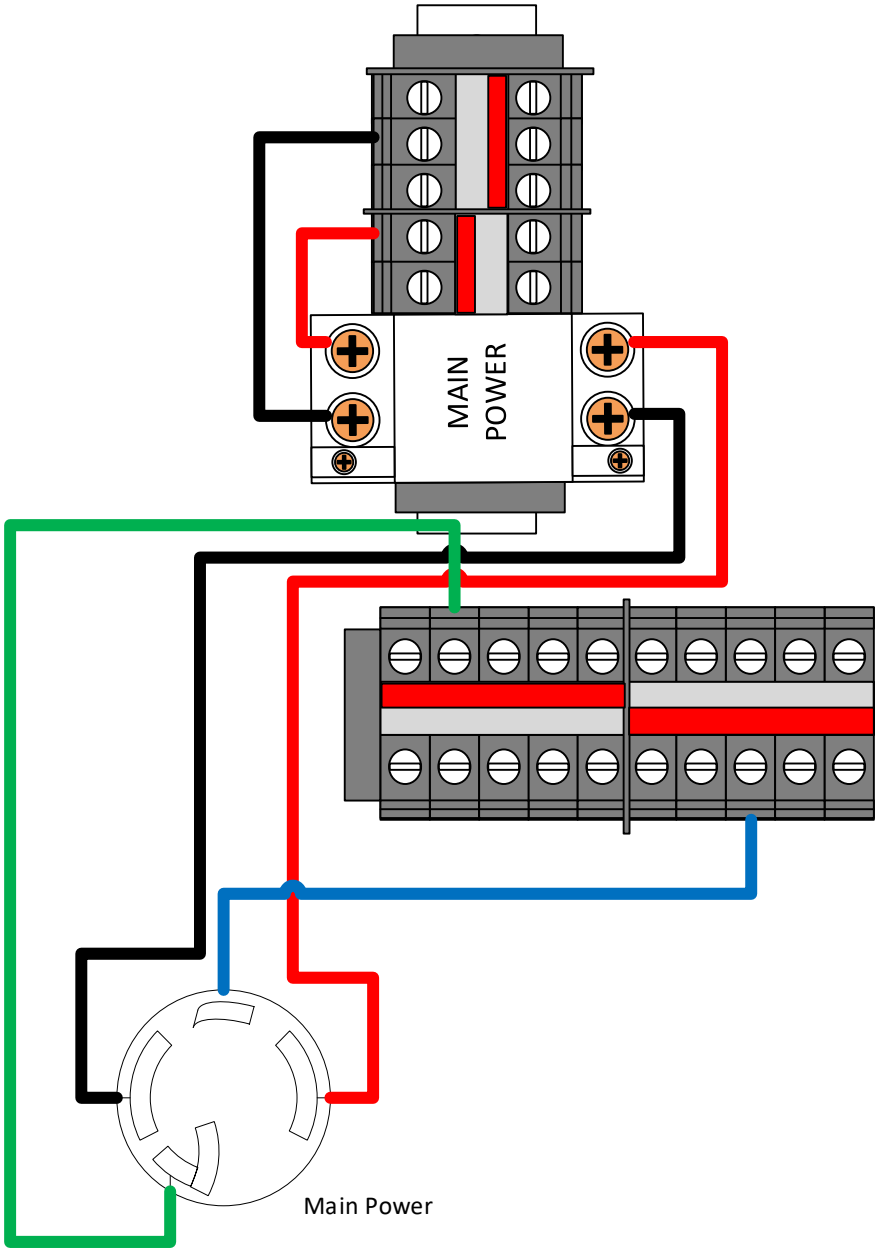
Wiring the Main Power switch and Green LED

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 or white wire, 10 gauge. For the Green line use 10-gauge wire as this will be ample.



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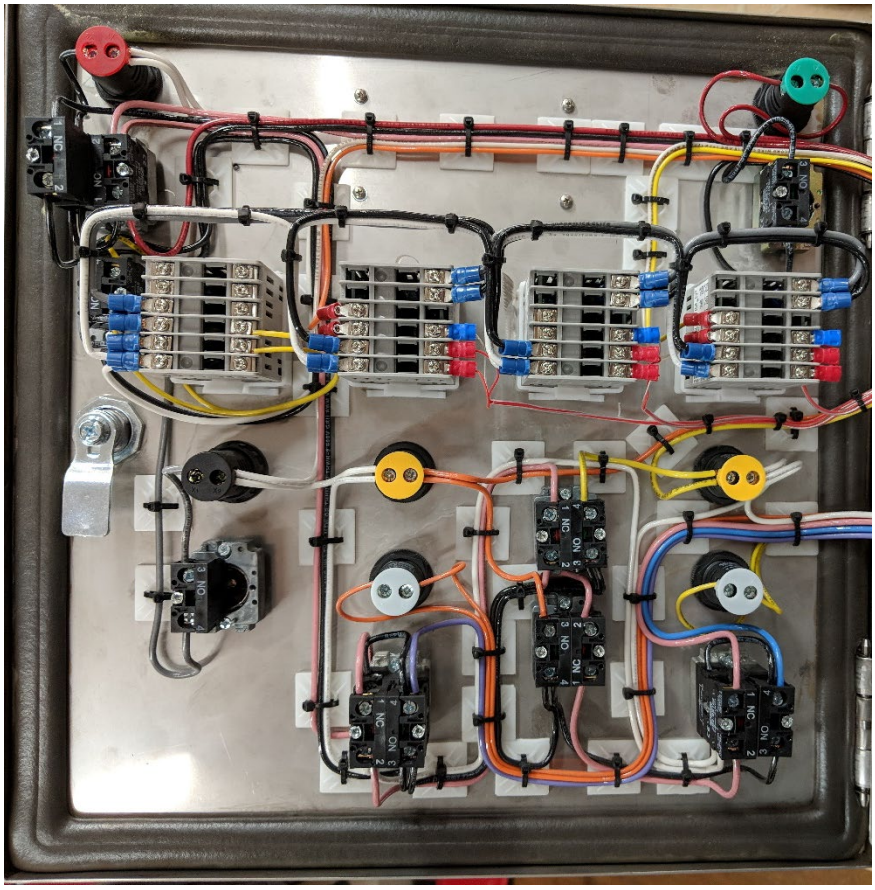
Wiring your Switches in

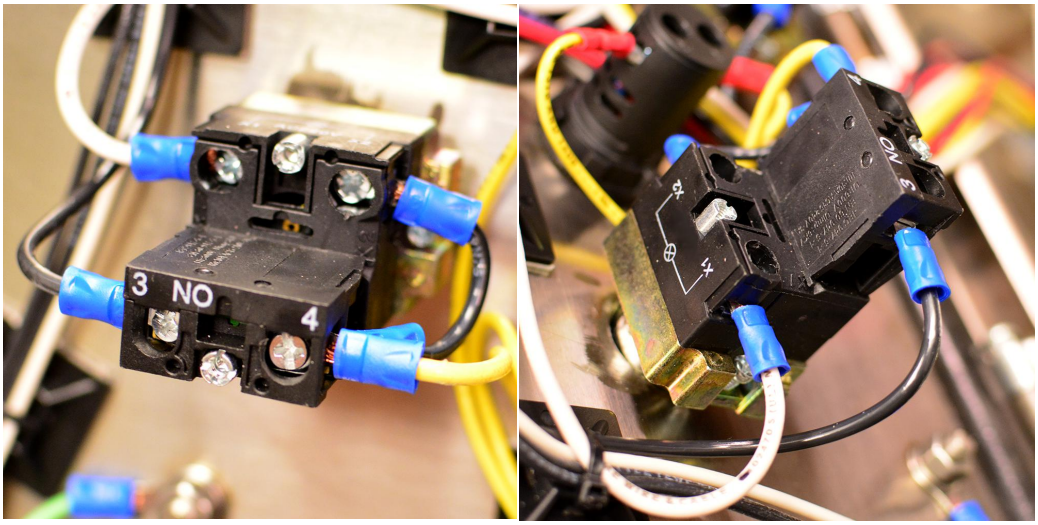


Wiring in your e-Stop

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.

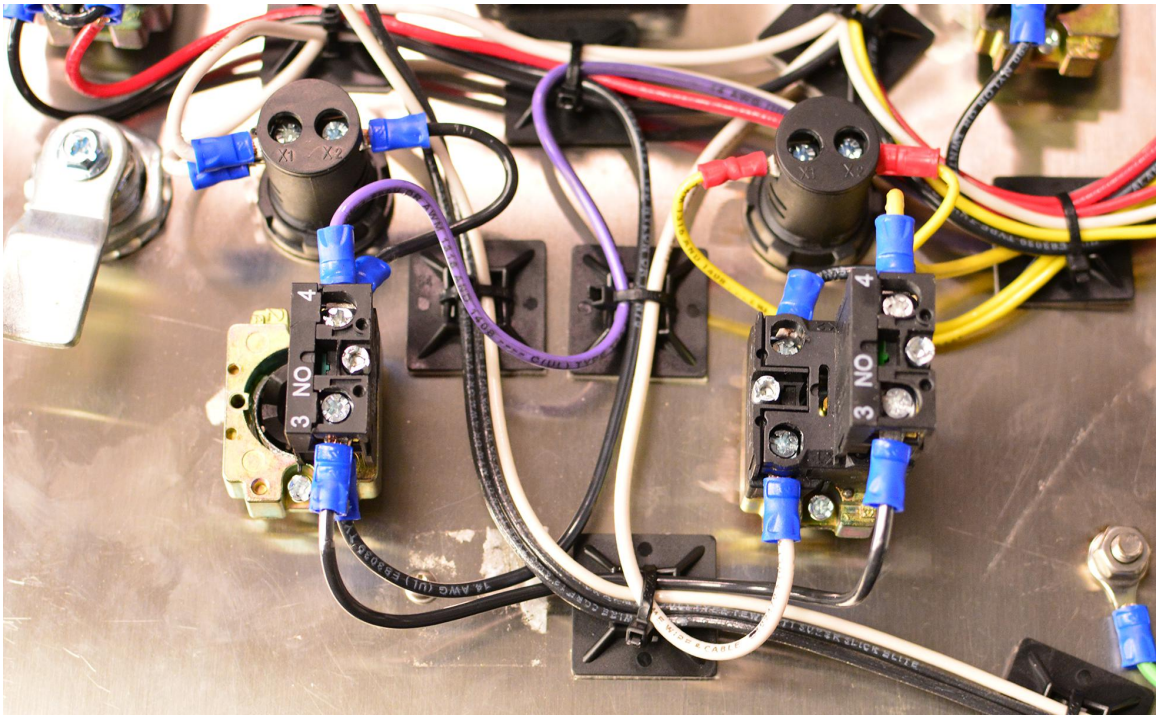
Wiring of LED Switches

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.



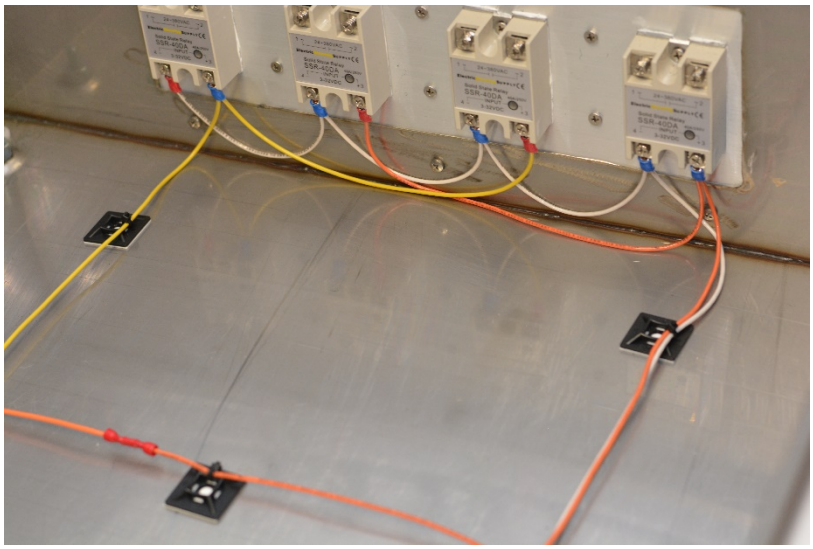
The above is an LED switch wired. The NC block has been removed to show the screws.

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.

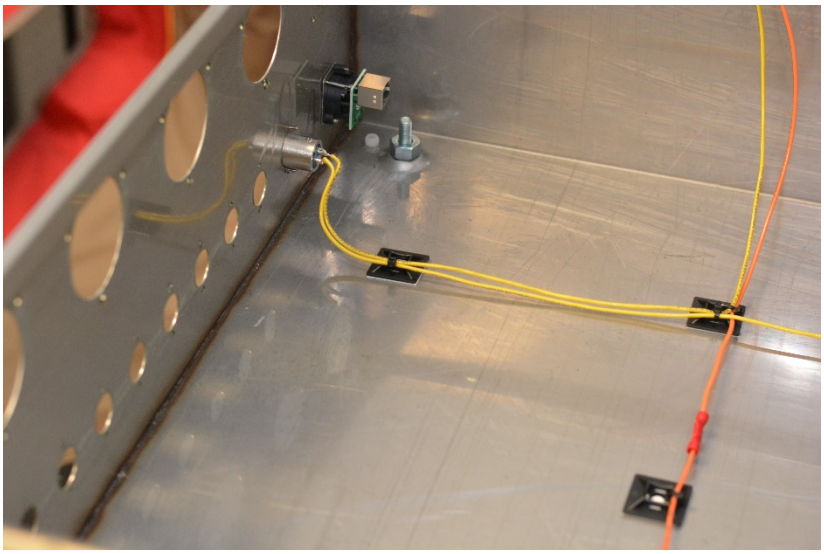


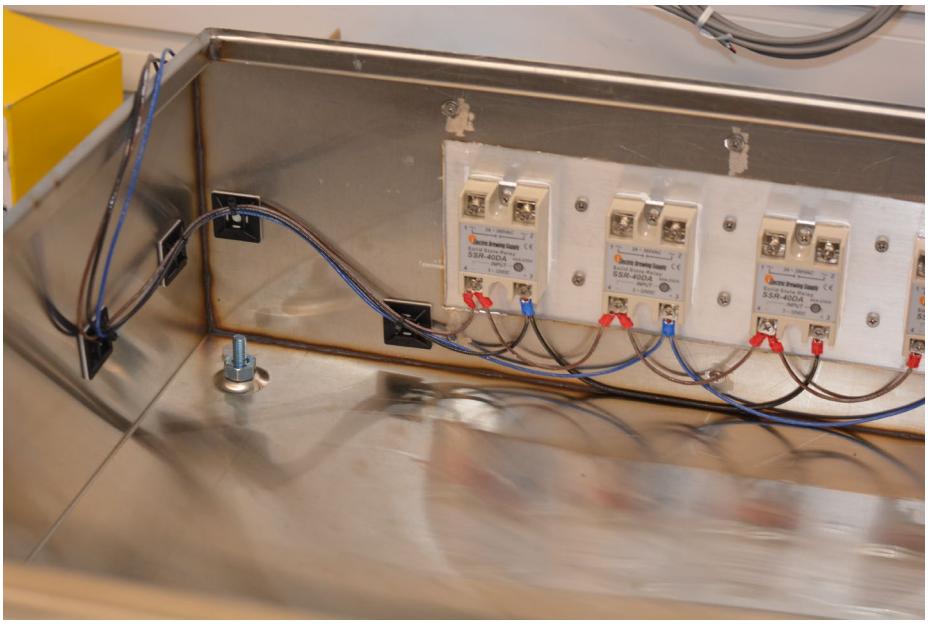
Bring it all together

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.

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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:

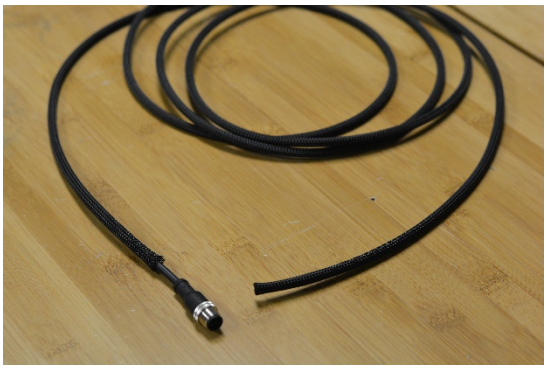
BCS will have 2 and 3 wire cables, in either case, only 2 are conductive, most often the Blue and Black wires. There is no polarity to the wires, therefore you can connect either color to the input or GND.

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

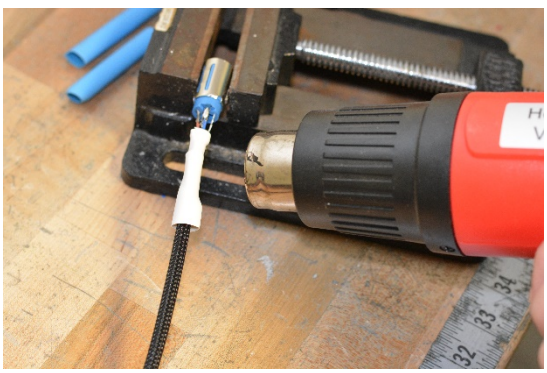


2. Cut the 4” heat shrink in half

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.



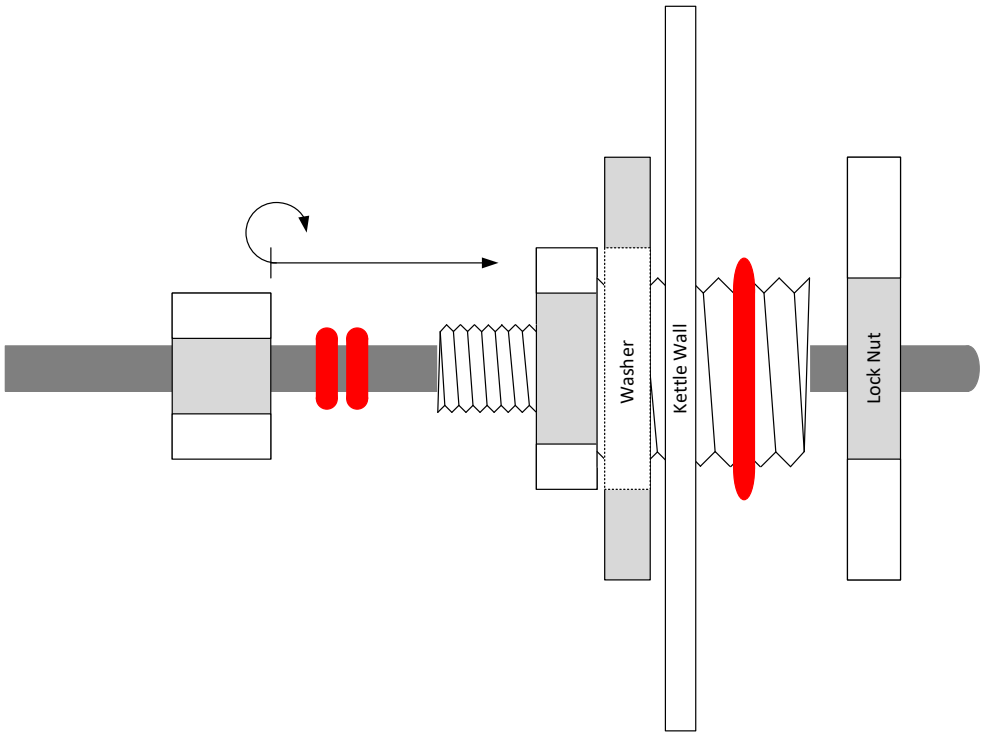
Mounting temp probes

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.

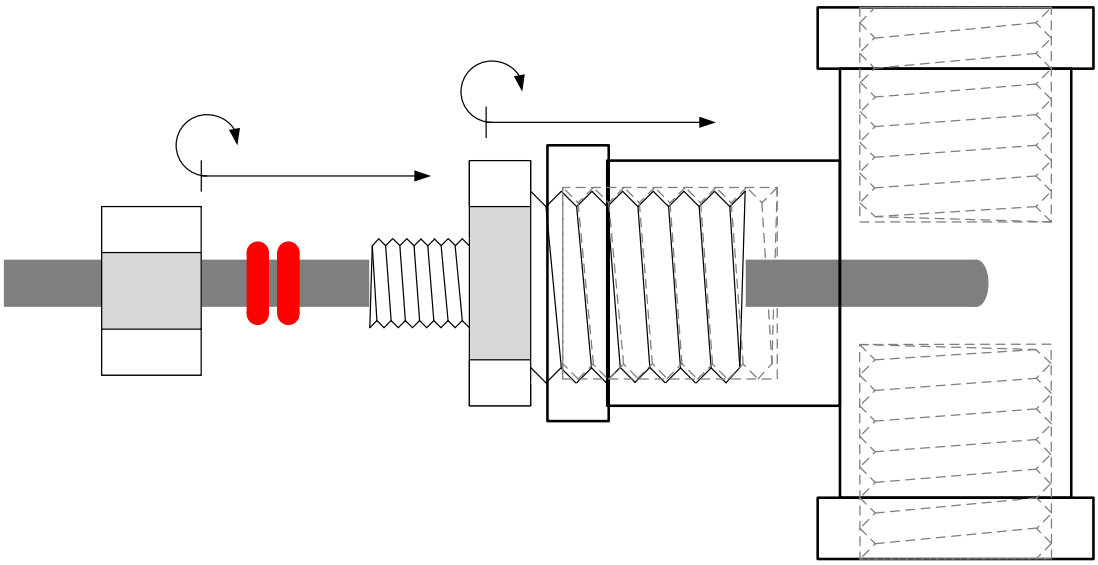
The usual mounting point in our system is on the walls of each of our vessels; however recently we've found the probe mount on the Mash tun from some manufacturers can actually be too high and ineffective. For this application we have begun using the probe in a T-fitting at the output of the HERMs coil 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.



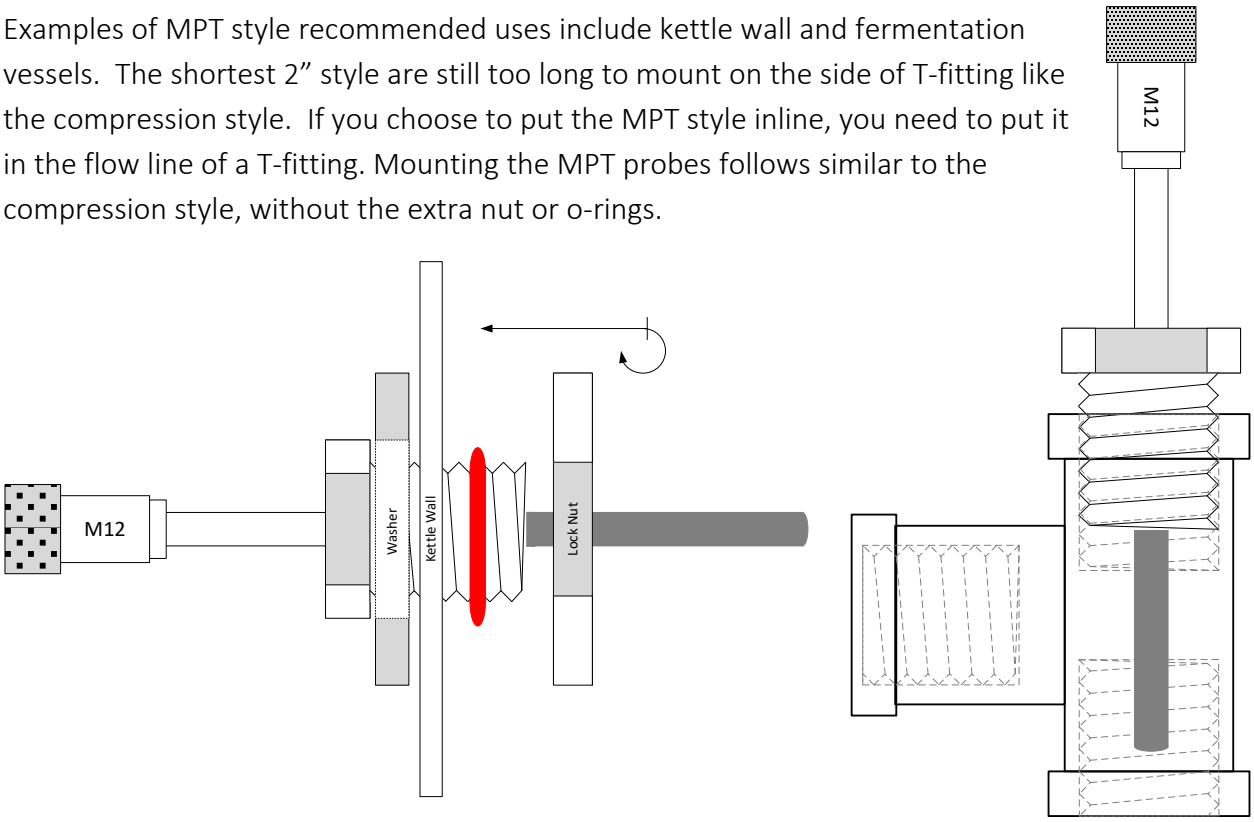
Recommended BCS Compression style mount in plumbing



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.

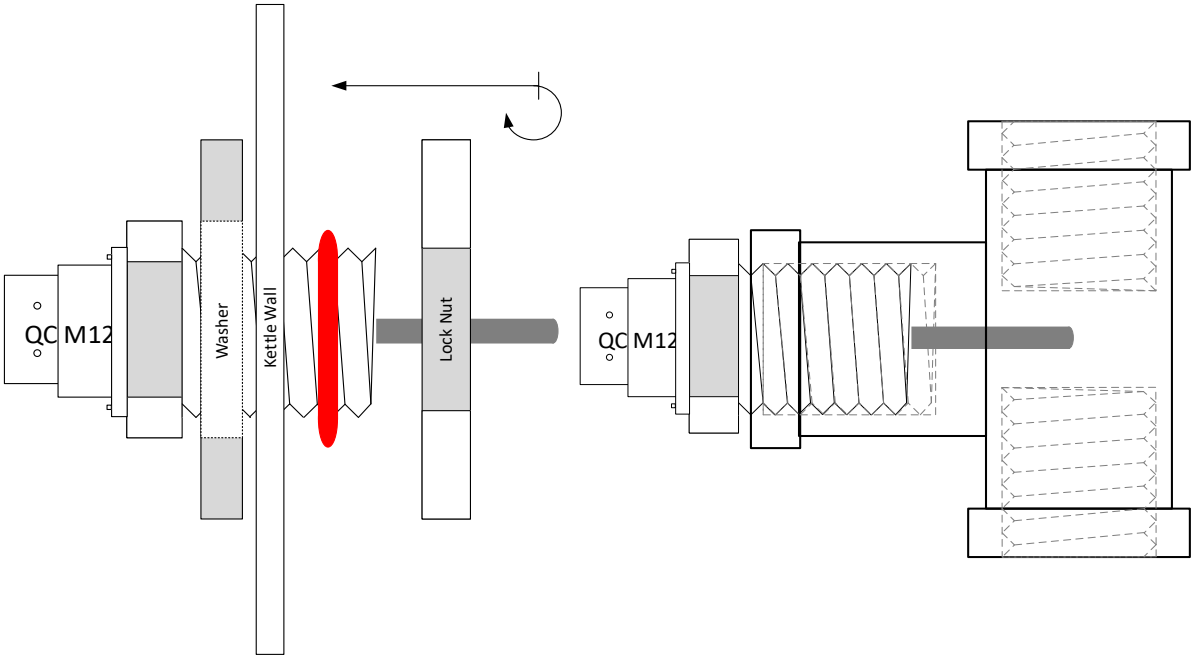


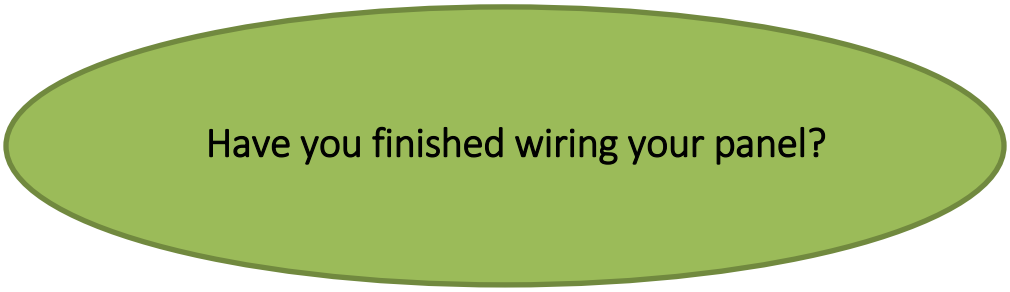
Tri-Clamp style BCS Probes

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.




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!

What you need to know about BCS Network Connectivity

By default, the controller attempts to obtain an IP address from a DHCP server (router). It is important to connect your BCS to your network before powering up.

Directly Connected

Directly connecting your computer to the BCS is not supported.

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 desire, or require, wireless connectivity, we highly recommend researching an affective wireless client adapter. We've tried many, but best bang for buck is usually TP Link.

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

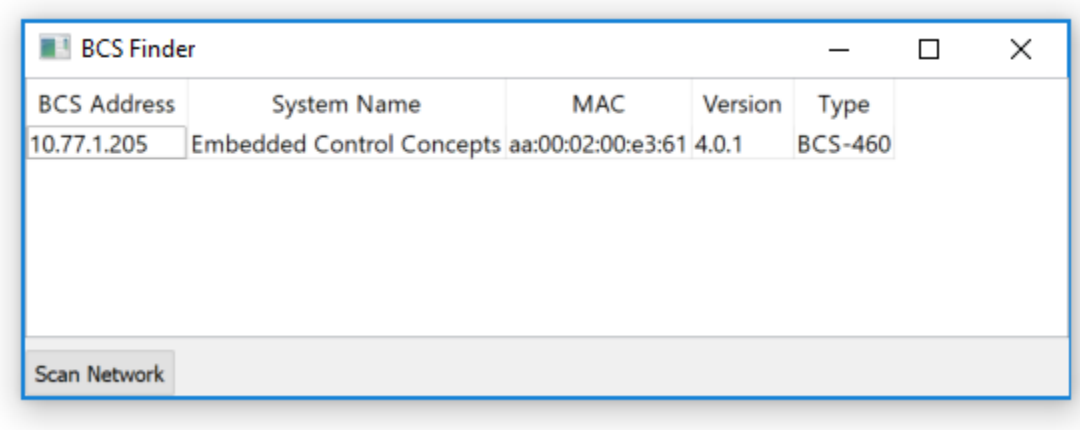
Another method to find the IP address is to log into the router and locate the BCS in the routers 'Connected Devices' list. Most have a default IP of 192.168.0.1 and will require a user and password (default user:passwd is usually admin:admin). In the router's status menu you will see a setup page for 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

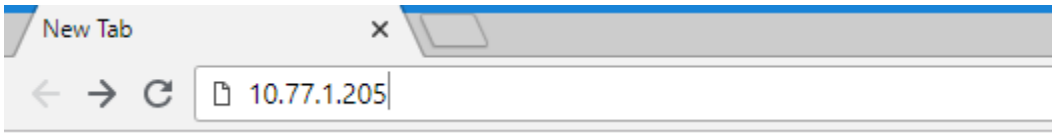
Once you have plugged your BCS into your home network and fired up your computer, point your web browser to http://bcsfinder.ebrewsupply.com. Download the utility, as this will make your life much easier moving forward.

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.

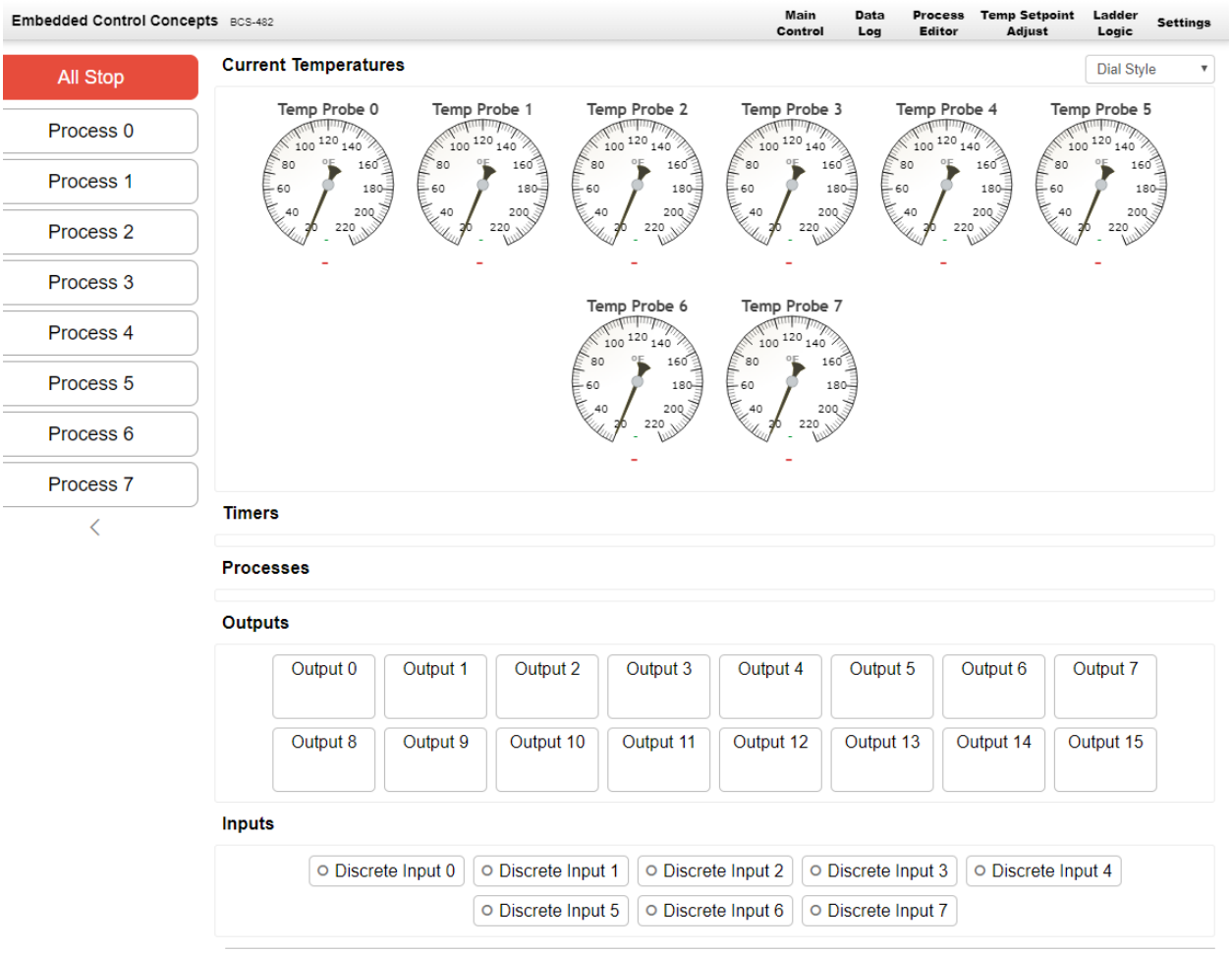
If lights are on, then load up the BCS finder application. You will get a screen that resembles the following.



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.



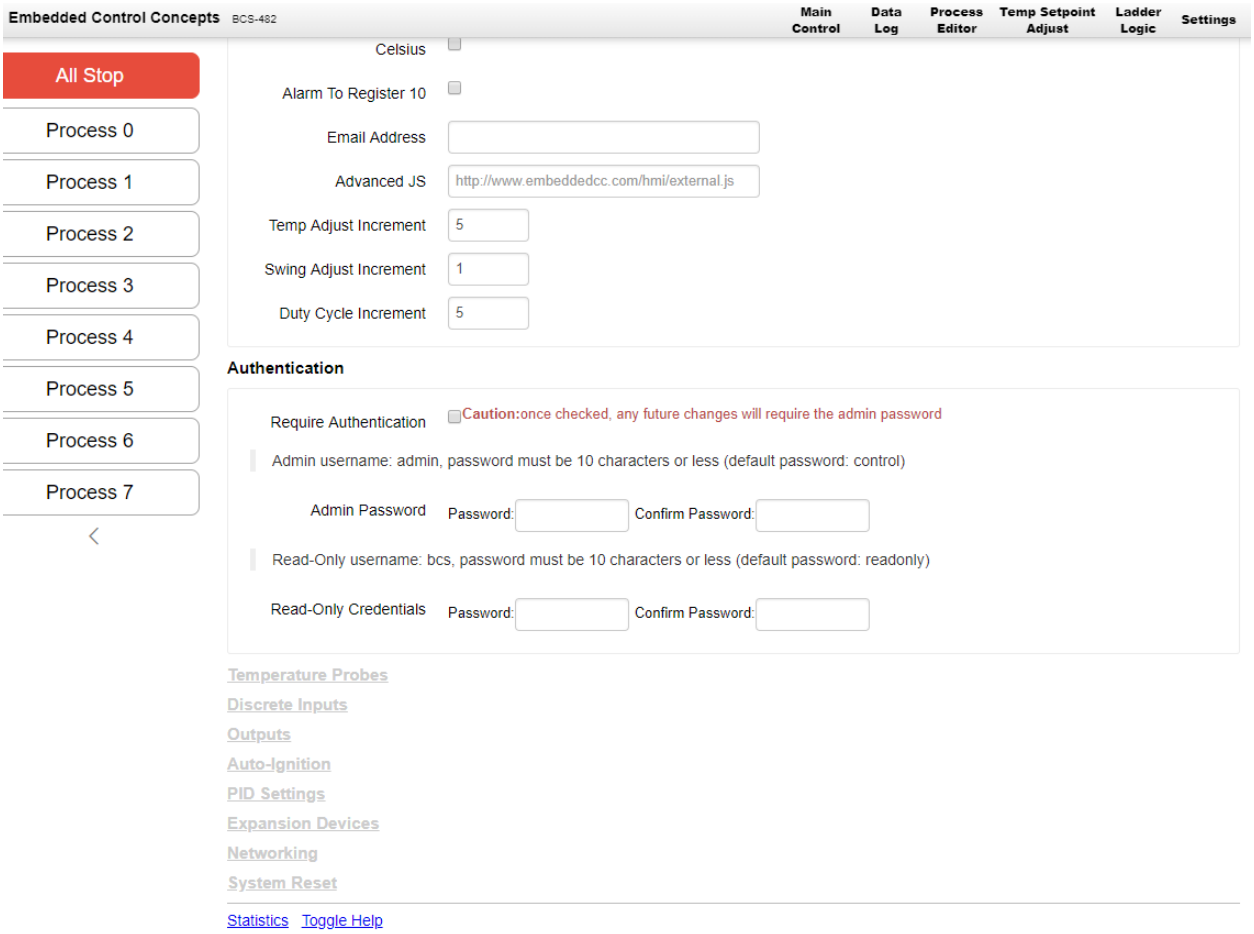
The resulting screen should resemble the following:



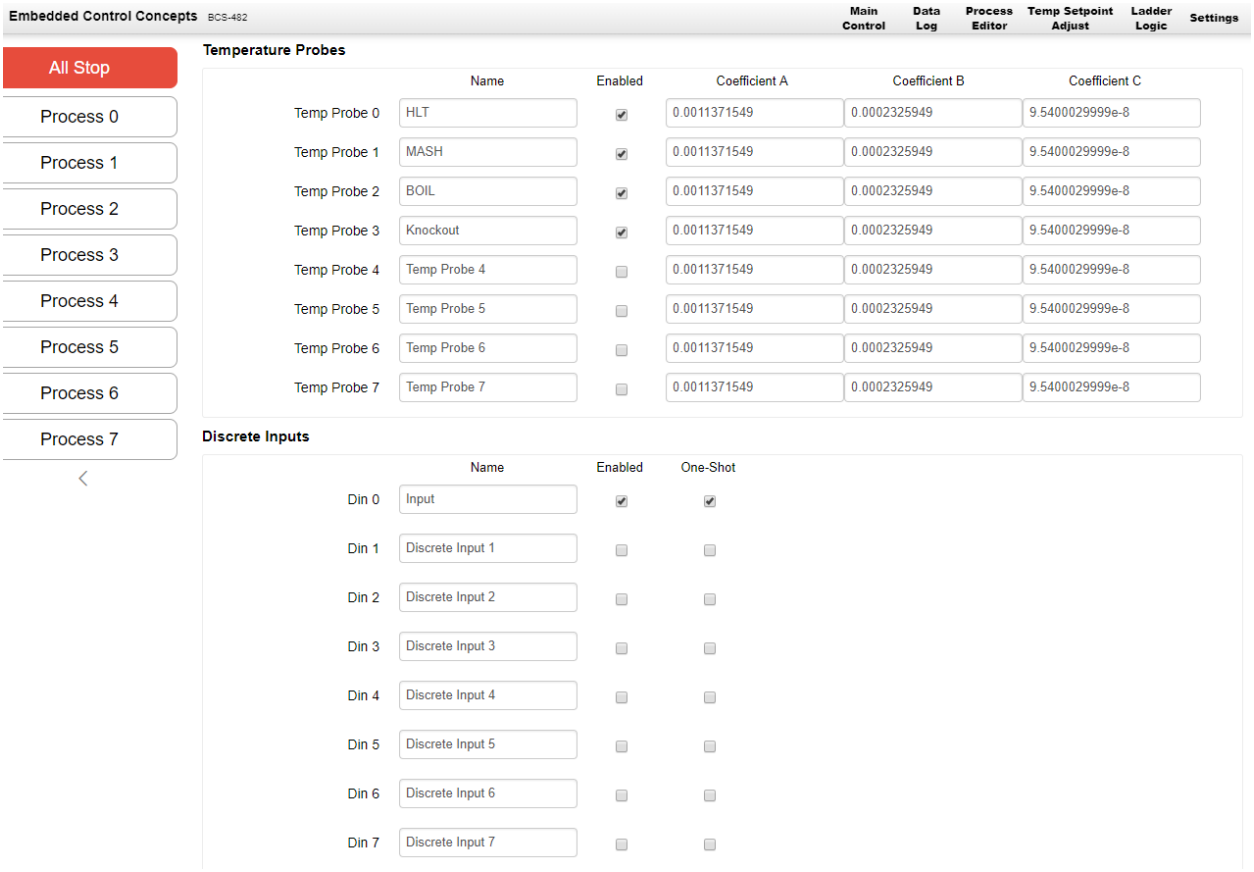
In the top right hand corner, select **System Settings**

System Settings: System Inputs and Outputs

From the settings screen scroll down:



Click on Temperature Probes, Discrete Inputs:



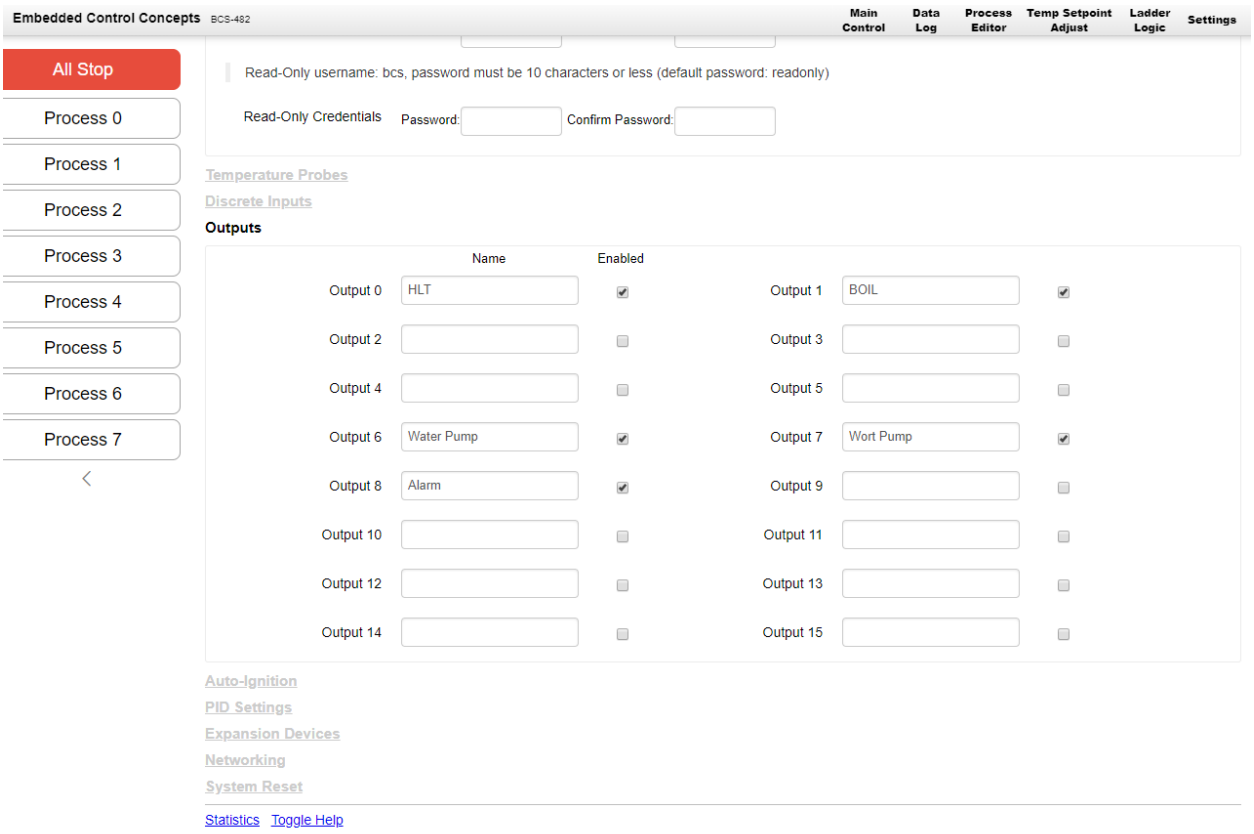
In the base BCS 50a and 30a control panel design, the only points of interest should be **Temp 0, Temp 1, Temp 2, Temp 3, Output 0, Output 1, Output 8, Output 9, Output 10**. If you purchased the temp probes after January 1 from Electric Brewing Supply or Brewers Hardware and you are using Firmware version 3.7.0 or later, your Thermistor Coefficients will already be correct.

For Temp 0 through 7, 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, the system will save automatically.

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:

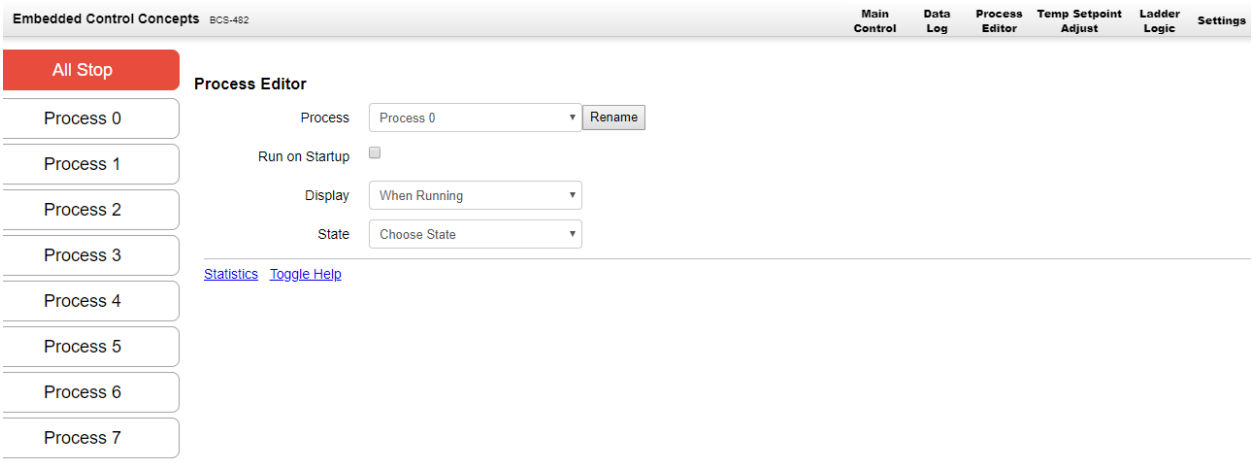


Edit Processes

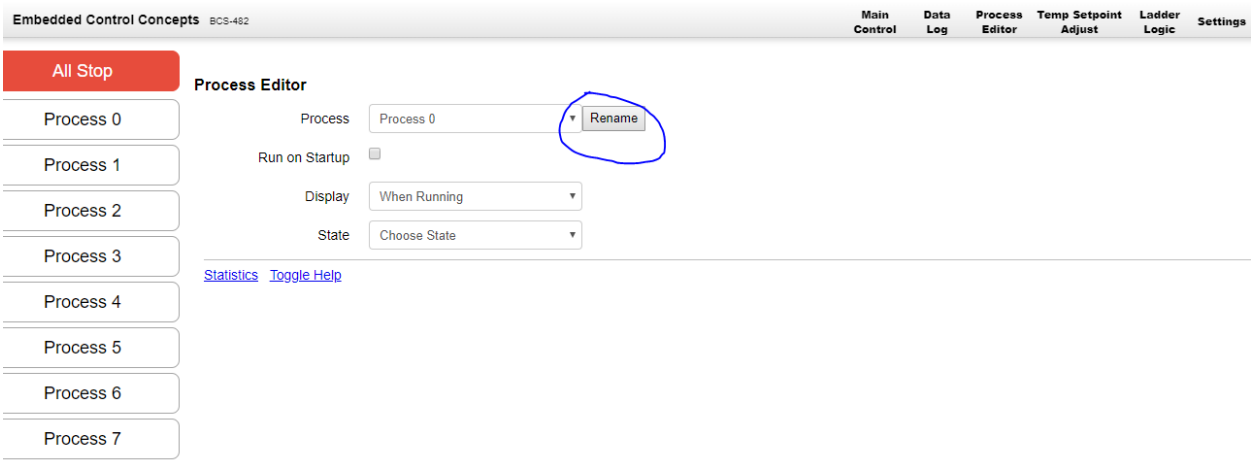
Now that you have configured your BCS, the key to using your BCS is your processes. These are the actual steps your automated system will take while you brew. Much of what you can do with these we will side step in an effort to give you the basics you need to get brewing.

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:

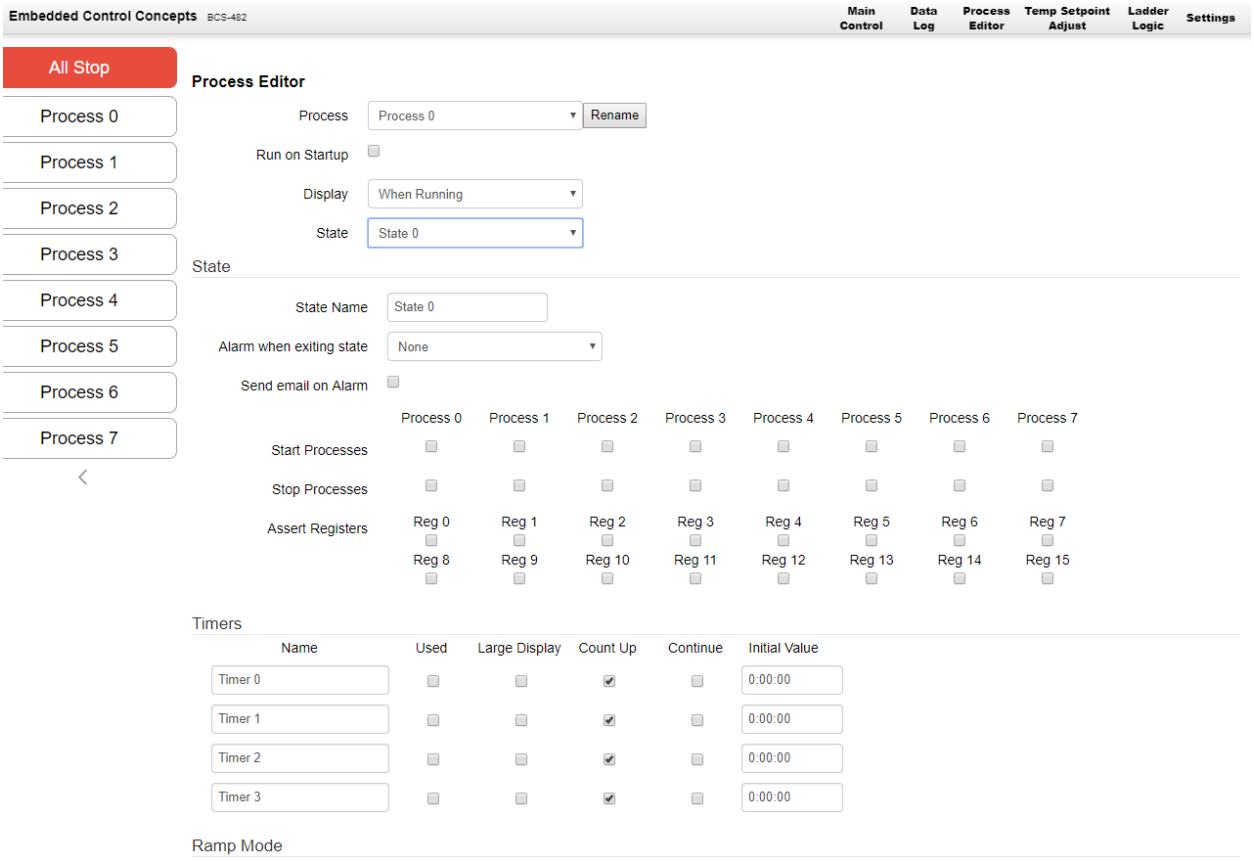


Note the fact that everything is vanilla at the moment, no name for the process, as well as for any of its states. We're going to change this by starting with naming.



Edit Processes: Naming States

Each state name can be changed as you edit them.



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. **The settings will automatically save with each change**

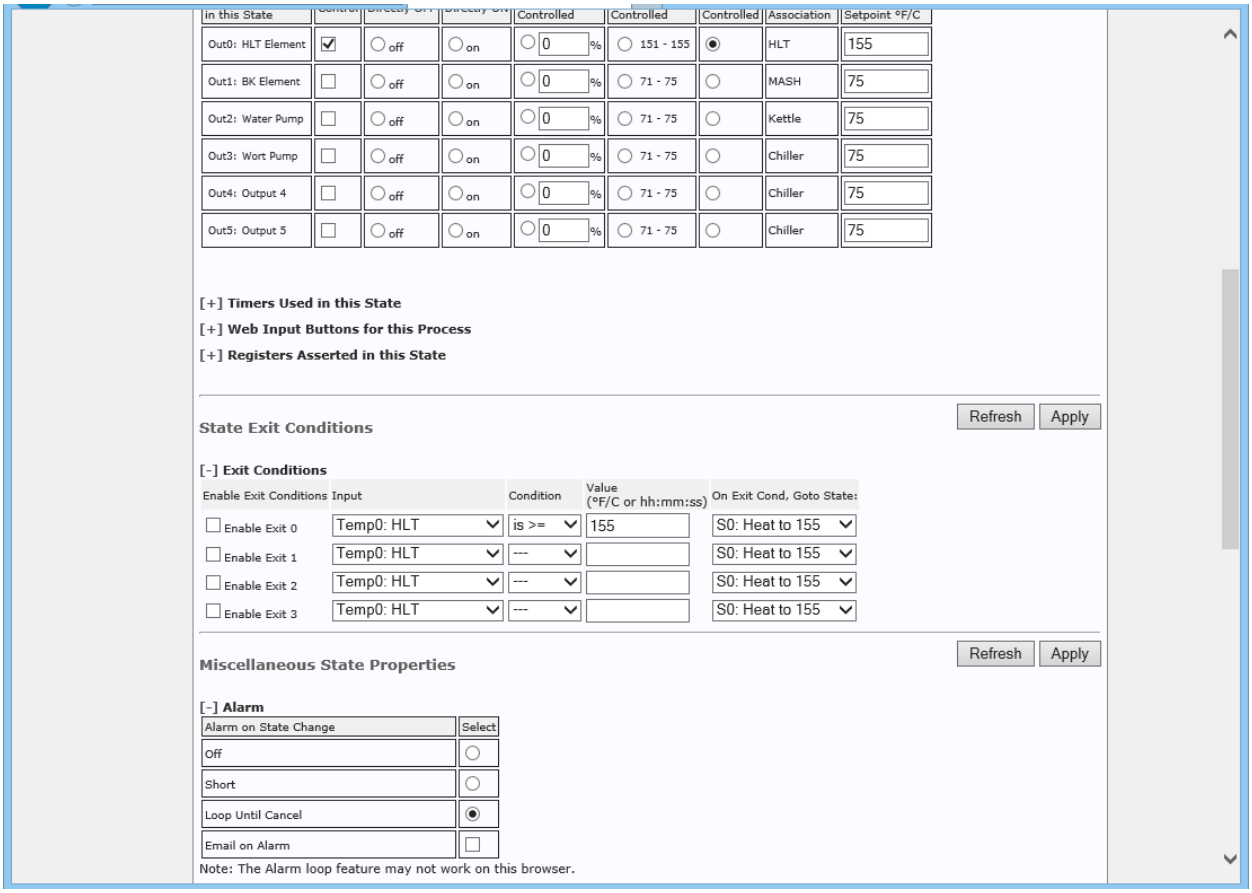
The result should resemble this:

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. **Settings will save you progress**



in this State				Controlled	Controlled	Controlled	Association	Setpoint °F/C
Out0: HLT Element	☑	off	on	0 %	151 - 155	◉	HLT	155
Out1: BK Element	☐	off	on	0 %	71 - 75	○	MASH	75
Out2: Water Pump	☐	off	on	0 %	71 - 75	○	Kettle	75
Out3: Wort Pump	☐	off	on	0 %	71 - 75	○	Chiller	75
Out4: Output 4	☐	off	on	0 %	71 - 75	○	Chiller	75
Out5: Output 5	☐	off	on	0 %	71 - 75	○	Chiller	75

[+] Timers Used in this State

[+] Web Input Buttons for this Process

[+] Registers Asserted in this State

State Exit Conditions Refresh Apply

[-] Exit Conditions

Enable Exit Conditions	Input	Condition	Value (°F/C or hh:mm:ss)	On Exit Cond, Goto State:
☐ Enable Exit 0	Temp0: HLT	is >=	155	S0: Heat to 155
☐ Enable Exit 1	Temp0: HLT	---		S0: Heat to 155
☐ Enable Exit 2	Temp0: HLT	---		S0: Heat to 155
☐ Enable Exit 3	Temp0: HLT	---		S0: Heat to 155

Miscellaneous State Properties Refresh Apply

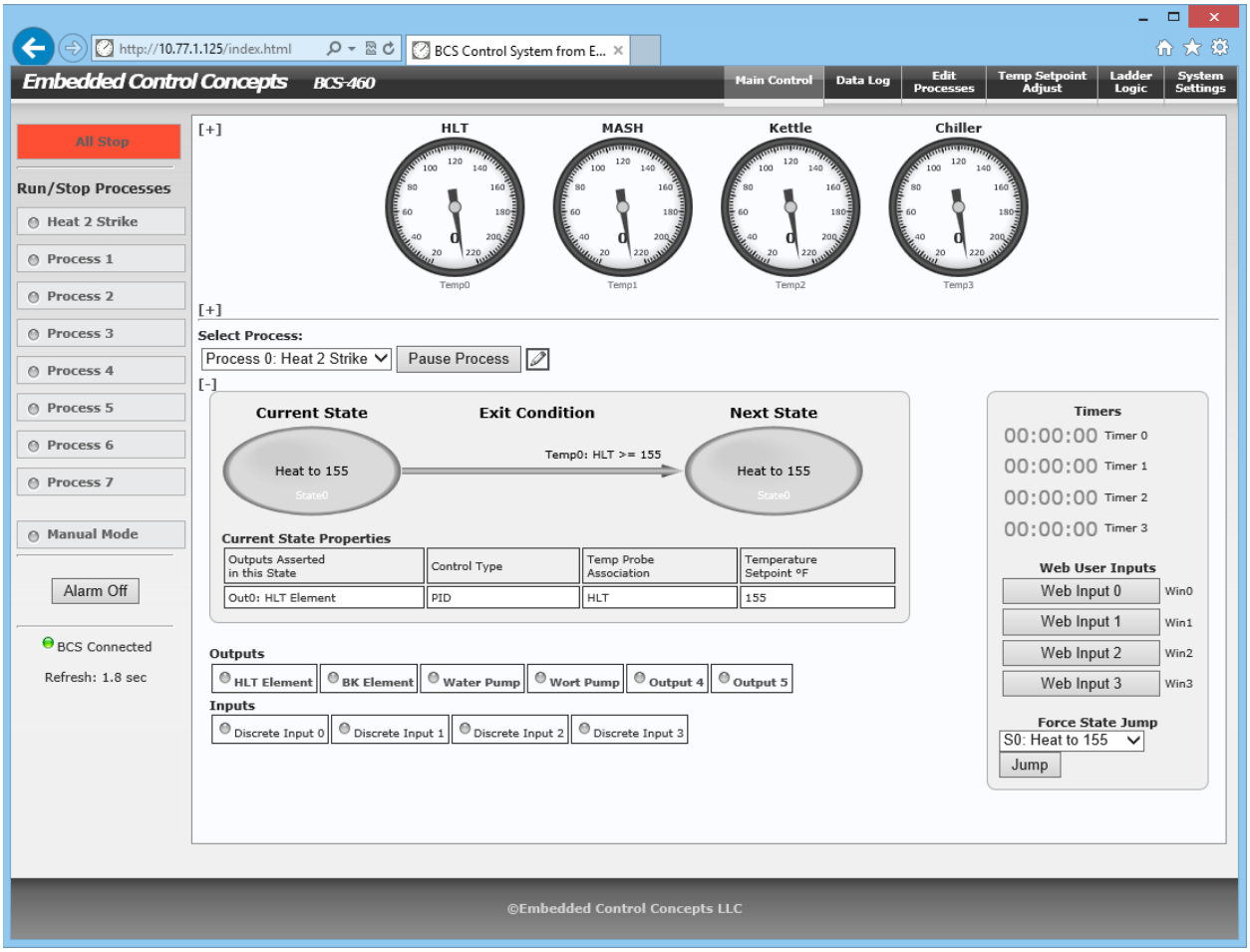
[-] Alarm

Alarm on State Change	Select
Off	○
Short	○
Loop Until Cancel	◉
Email on Alarm	☐

Note: The Alarm loop feature may not work on this browser.

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

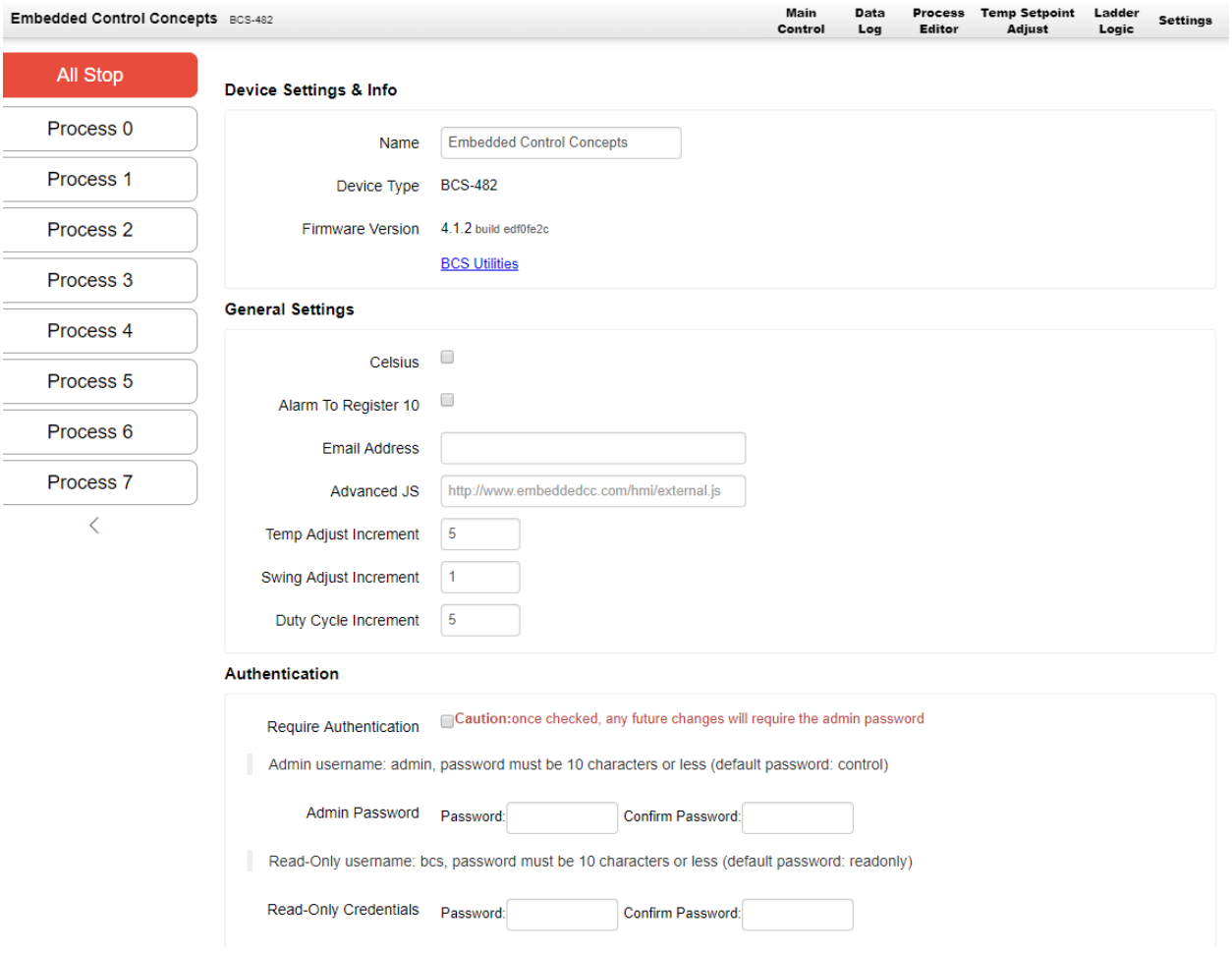
It's important to note, these are not the only process solutions, trial and error will play into your process development as you find what works best for your brew process. The goal was to keep it simple, as it should be, but also cover as much as we could to help you get started.

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

The BCS Utilities

BCS Utilities page will help you back up your BCS unit once everything is programmed.



If you would like, email us at support@ebrewsupply.com and we can supply a restore file to get you started from.

Programming your PID

As you finish your panel, you should find 3 PIDs and a timer. The 3 PIDs and a timer are tentatively programmed, but lets make sure everything is set up correctly for your brewing needs.

Looking at your PIDs first, you want to make sure that you have the correct temperature input, the correct temperature unit, and once these are done, you'll begin the process of auto tuning the HLT and move to the timer.

Setting your PID input to PT100/RTD and temperature unit

Press **SET** and **<** buttons, you should see **PASS**.

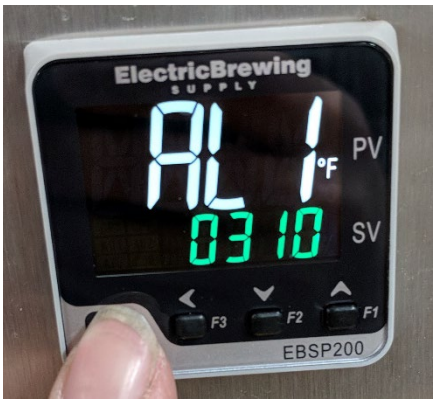
Using the arrows, change the pass code to **0101**.

Using the set button you can change the menu value, in this case the first value should be Input **(INP1)**. The **SV** setting should read **PT**. This is usually set for us by the factory, but worth a confirmation.

The second setting should be the third menu option, **UNIT**. The setting for this should be your preference, there are two choices.

Once the 2 options are set how you desire, be sure to press **SET and <** again to return to the temperature **SV** and **PV**. The **PV** should read the ambient temperature in your kettle.

PID Alarm function



To set a high alarm, press SET until you see AL1.

Use the arrows to set your high temp. To disable the alarm, set your temp beyond your working temp zone.

PID Boil / Manual functionality

To bring your kettle to a boil, you can set the temp for 212 or go straight into manual mode. Manual mode allows you to dial in the electrical output so that your boil doesn't get to vigorous and boil over. To set to manual mode, press SET, the first menu item to come up should be AM.RS; set this to Man. Press set to return to PV/SV home again. Once in manual your SV line will change to 0-100% range.

Auto Tune your PID

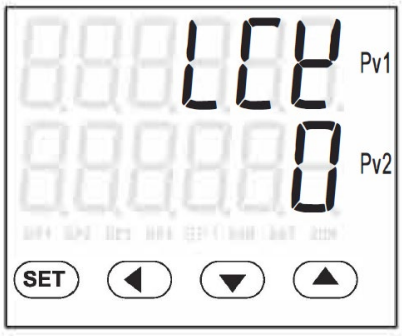
The auto tune steps are purposely deep in the menu. Once you auto tune your kettle you shouldn't need to do it again. That said, if you change your kettle or process you'll need to tune it again. To start the auto tune process, set your SV temp to 150 degrees.

Once your kettles and panel are setup, for an effective use of your panel, you need to auto-tune your HLT PID controller. This insures proper calcs resulting in efficient use of the heating element(s). You only need to do this for your HLT PID.

To start the auto tune process, bring your kettle to approximately 150 degrees, once close, press the SET and < buttons until you see PASS. Enter code 0033 and press set. Select F02 and press Set. Set At to *YES* and press the SET button again until you se your PV again. You'll see ATU blink in the bottom right while it auto tunes. The auto tune process isn't a precise period, but it typically will run about 30 to 60 minutes. Once it's over, ATU will disappear.

Programming your timer

Your timer can be programmed a couple ways, but we'll discuss the method we use and recommend. This method is a count down timer that will trigger the alarm when the timer reads 00:00:00.



To start the programming, press SET until you see LCK.

Change the code to 104 and repeat with code 12.

You will change the following menu items in sequence. It's critical you follow the sequence as it will help keep it straight for you.

Code 104	Code 12
PrP => 2	d1 => 4
Pr0 => 00	d2 => 1
Pr1 => 00	run => 1
G01 => 2	
Pr2 => 01	
G02 => 0	

Continue pressing set until it returns to the timer screen.

At this point, you should be all set to use the timer. When you use your timer, you will use the START button on your door to start the count down. Setting your timer involves changing the time you want the timer to run by pressing SET to show T1. T1 will be your count down time. Press SET again for T2. T2 is the time window that your alarm will sound; this can be as long or short as you like. Once you set both, press SET until you see your times again. Pressing START should start the countdown.