Zoom On/Off Switch Install Guide

Preliminary Notes:

- Thick black outlining [below], which group rows, indicate connections within 8P8C Cat/Ethernet surface mount boxes, on screw terminals, at respective locations designated by column headers; the pulpit/podium has two boxes each cut in half, retaining all 8 Ethernet fork crimped ends connected to their RJ-45 female connectors, and retain 4 screws each, for 8 screws total, similar to the 8 screws on 1 surface mount box: this allows two RJ-45 male cables to be patched together onto those 8 screws.
- The typed color designations for Ethernet wires, mentioned herein, pertain to the colors of their fork crimped wire leads that are part of the 8P8C Cat/Ethernet surface mount box RJ-45 connectors, not to the colors of the Ethernet wires themselves, which are male crimped and insert into those female RJ-45 jacks.
- Table cells with visual color, herein, are to indicate two ends of a wire (and their fork crimped connections within the 8P8C Cat/Ethernet surface mount boxes); they do not represent spliced connections as do the black outline groupings of cells.
- The Ethernet wire numbering herein is arbitrary, so that you can match one end of a wire to where it is listed elsewhere herein: it does not follow the pinout numbering of the female RJ-45 connectors.
- ‘to’ and ‘from’ designations are relative to conventional circuit flow rather than electron circuit flow. The following arrow symbols are used to point the flow (if you can call it that) from positive to negative, within a boxed grouping that indicates a spliced connection: ↓↑; the following arrow symbols are used to point the flow from positive to negative, within a visual color indicating two ends of a wire (including the 8P8C Cat/Ethernet forked crimped leads): ← →.

Wiring Connections:

Attic Entrance	Pulpit/Podium	Bishop's [controls] Pedestal
12V power positive (solid black, NO dashed white stripe) (↓)		
Filn 19mm latching switch brown (common)		
Filn 19mm latching switch gray (normally open) (↓)	Ethernet 2 wire 1 brown (→)	Ethernet 2 wire 1 brown (↓)
Ethernet 1 wire 1 brown (→)	Ethernet 1 wire 1 brown (↑)	Jumper wire 5 [22 AWG black in 4 conductor cable] (to 2-port Wago 221-412 with NKK toggle switch black lead [to terminal 2, which is pole 1])
Filn 19mm latching switch orange (normally closed) (↓)	Ethernet 2 wire 2 orange (→)	Ethernet 2 wire 2 orange (↓)
Ethernet 1 wire 2 orange (→)	Ethernet 1 wire 2 orange (↑)	Jumper wire 6 [22 AWG yellow in 4 conductor cable] (to 2-port Wago 221-412 with NKK toggle switch blue lead [to terminal 5, which is pole 2])
Ethernet 1 wire 3 blue (↓)	Ethernet 1 wire 3 blue (←)	Jumper wire 7 [22 AWG green in 4 conductor cable] (from 3-port Wago 221-413 with NKK toggle switch white lead [from terminal 1, which throws from pole 1 when toggle is UP], and with NKK toggle switch green lead [from terminal 6, which throws when pole 2 is DOWN]) (↓)
Jumper wire 1 [red] (to IOT relay positive)	Ethernet 2 wire 3 blue (↑)	Ethernet 2 wire 3 blue (←)
Jumper wire 2 [white] (from IOT relay negative) (↓)	Ethernet 2 wire 4 green (unused with taped end)	Ethernet 2 wire 4 green (unused and alone in a screw terminal)
Ethernet 1 wire 4 green (→)	Ethernet 1 wire 4 green (↓)	
Filn 19mm latching switch green (green LED in)	Filn 22mm momentary switch green (green LED in)	

Ethernet 1 wire 5 yellow (↓)	Ethernet 1 wire 5 yellow (←)	Jumper wire 8 [22 AWG red in 4 conductor cable] (from 3-port Wago 221-413 with NKK toggle switch red lead [from terminal 3, which throws when pole 1 is DOWN], and with NKK toggle switch yellow lead [from terminal 4, which throws when pole 2 is UP]) (↓)
Jumper wire 3 [red] (to 2-port Wago 221-412, with 2600 ohm resistor [color bands are 2600 ohm, sold as 2700 ohm], to 2-port Wago 221-412 with Jumper wire 4 [close end; white])	Ethernet 2 wire 5 yellow (↑)	Ethernet 2 wire 5 yellow (←)
Jumper wire 4 [far end; white] (↓)	Ethernet 2 wire 6 red (unused with taped end)	Ethernet 2 wire 6 red (unused and alone in a screw terminal)
Ethernet 1 wire 6 red (→)	Ethernet 1 wire 6 red (↓)	
Filn 19mm latching switch red (red LED in)	Filn 22mm momentary switch red (red LED in)	
Ethernet 1 wire 7 black (↓)	Ethernet 1 wire 7 black (←)	
Filn 19mm latching switch black (LEDs out) (↓)	Filn 22mm momentary switch black (LEDs out) (↑)	
12V power negative (black WITH white dashed stripe)	Ethernet 2 wire 7 black (unused with taped end)	Ethernet 2 wire 7 black (unused and alone in a screw terminal)
Ethernet 1 wire 8 gray (unused with taped end)	Ethernet 1 wire 8 white (I used a different brand of 8P8C Cat/Ethernet surface mount box here [2 of them], as compared to other locations, and the white forked lead is the gray equivalent of the others; unused with taped end)	
	Ethernet 2 wire 8 white (I used a different brand of 8P8C Cat/Ethernet surface mount box here [2 of them], as compared to other locations, and the white forked lead is the gray equivalent of the others; unused with taped end)	Ethernet 2 wire 8 gray (unused and alone in a screw terminal)

Fork crimped leads, in 8P8C Cat/Ethernet surface mount boxes used (both brands), had the following colors matched to the actual Cat cable (Ethernet) wires:

Fork crimped lead color	T-568B Pin	T-568B Cat cable (Ethernet wires)
Blue	1	White/Orange
Orange	2	Orange
Black	3	White/Green
Red	4	Blue
Green	5	White/Blue
Yellow	6	Green
Brown	7	White/Brown
White (or Gray)	8	Brown

The Leviton 8P8C Cat/Ethernet surface mount boxes used at the attic entrance, and Bishop's pedestal, were of better quality than the Commercial Electric ones used at the pulpit/podium. It is recommended to use the Leviton ones for any future needs.

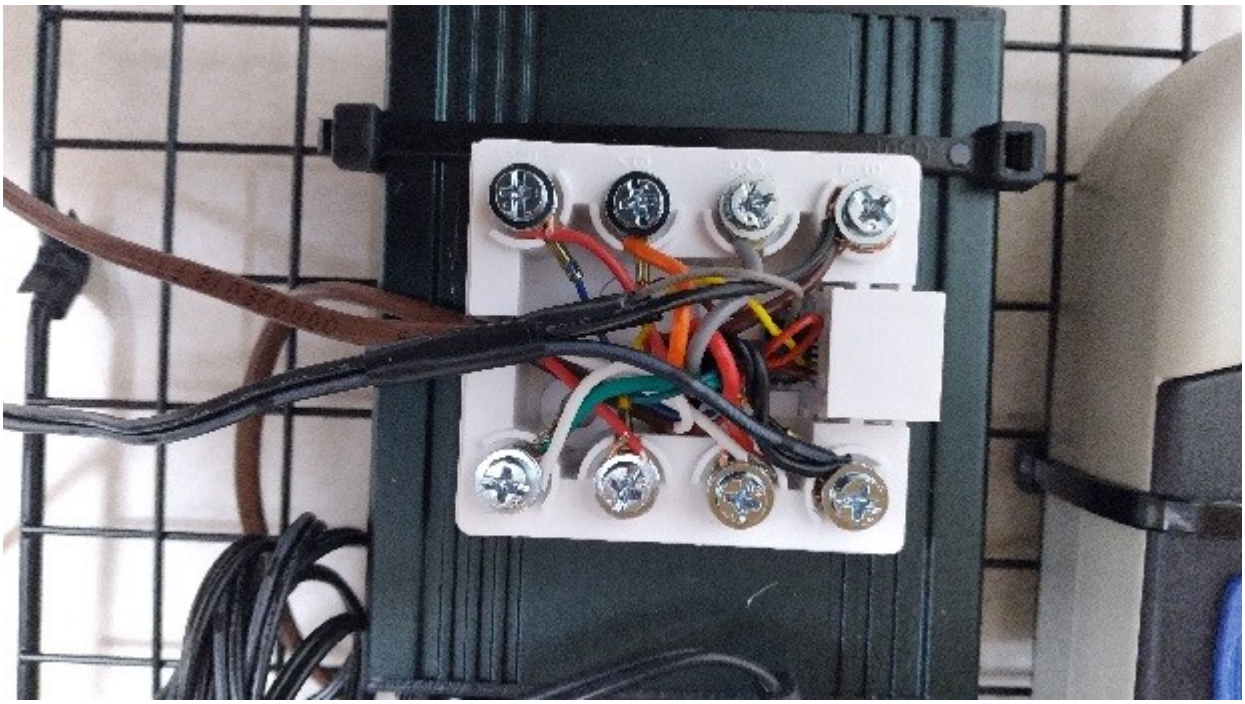
Additional Notes:

- The Filn 19mm switch in the attic entrance is latching, so it holds the selection, whereas the Filn 22mm switch at the pulpit/podium is momentary because it is only used for its indicator LEDs and not as a switch, hence if someone were to press its switch button inwards, it wouldn't hold the selection when they remove their finger, and thus it would always keep the LED ring outwards, and most visible, rather than latched inwards, obstructing some of the view of it.
- 22mm was used at the pulpit/podium rather than 19mm due to sourcing availability, and a switch with indicator LEDs was used there rather than just an indicator light, because indicator lights have notoriously small wire leads, which aren't very robust for wrapping around screw terminals, or inserting into Wago lever connectors [Wago 221 series can take up to 24 AWG but I've had them cut through 24 AWG, so I prefer 22 AWG or larger diameter [smaller AWG number] for most connections, and thus 8P8C Cat/Ethernet surface mount boxes, with crimped fork connector leads, were used to get from Ethernet to those other connected wires. There are Wago lever connectors of a different series that can take as little diameter of wire as 26 AWG wire, but the risk of cutting through 24 AWG is perhaps similar, and Wago 221 series connectors are rectangular shaped, hence they may be taped adjacently the more easily.
- The Filn 19mm latching switch is necessarily at least SPDT [it needs one pole and two throws [normally open and normally closed]; the NKK toggle switch is necessarily at least DPDT [it needs two poles and two throws; together this enables two switches to control two light colors, as opposed to two '3-way' switches, as they are called [SPDT], in a house, which can control one light color, and otherwise turn it off [not illuminated]. The SPDT switch (19mm, in the attic) changes which pole gets electricity on the second switch, and because each of the poles on the second switch (NKK, at the pedestal) have two throws, it can toggle between green and red, and due to how the throws of each pole of the second switch (NKK) are reversed relative to one another, the first switch (19mm) can also toggle between green and red.
- Wago 221 series were needed at the Bishop's pedestal for the NKK toggle switch because it has 16 AWG wire leads, and the 8P8C Cat/Ethernet surface mount boxes can't well hold bigger diameter wire than 18 AWG.

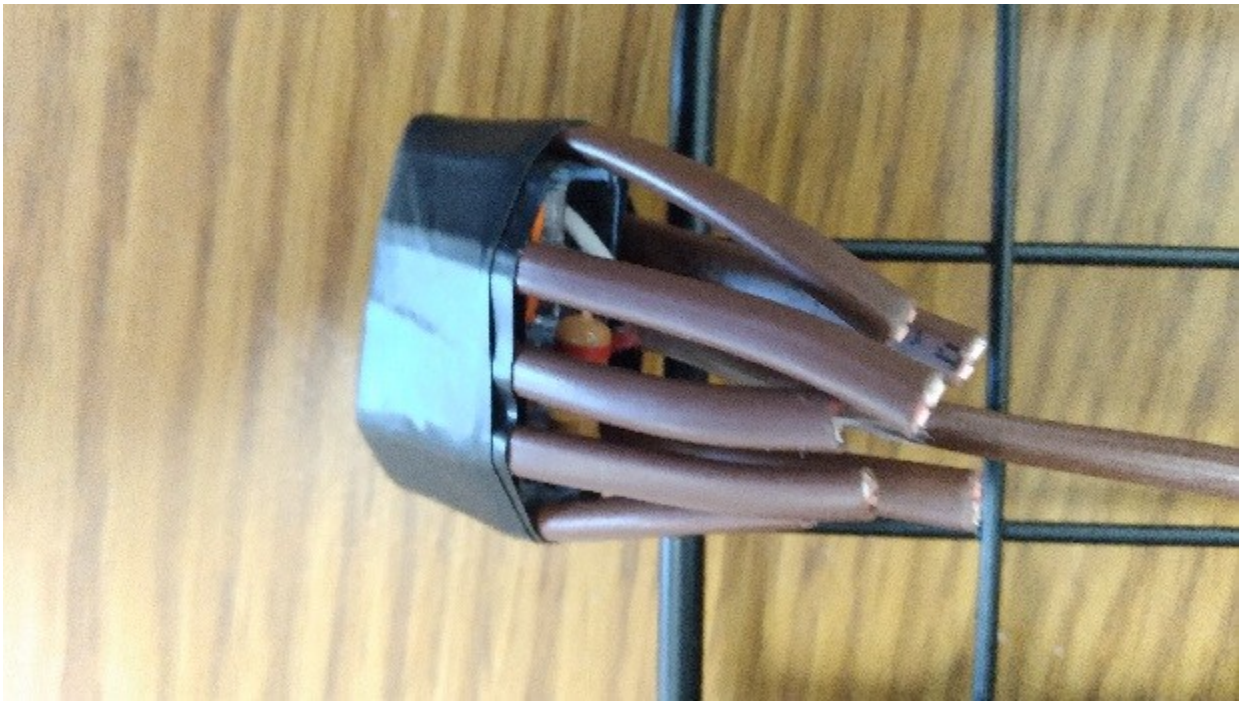
- The IOT relay also has its own green LED, labeled ‘Active Switch’, which turns on when the circuit with the other green LEDs is completed (via the switches letting the circuit through, and not diverting to the red LEDs). The HDMI repeater also has a red LED that indicates when it has power (so it would correspond with green LEDs, and the IOT relay ‘Active Switch’ LED); Tech specialists in the attic should generally just observe the Filn 19mm latching switch and indicator LEDs, which LEDs are similar to the indicator at the pulpit/podium, to avoid confusion.
- The Extron distribution amplifier is ‘Active Out’, which means it doesn’t need to negotiate EDID to send out; if the delay is too long after turning the switches on, you can change Extron settings to get it to stop trying to use the EDID of the sink device.

Pictures:

Attic entrance 8P8C/Cat/Ethernet surface mount box wiring:



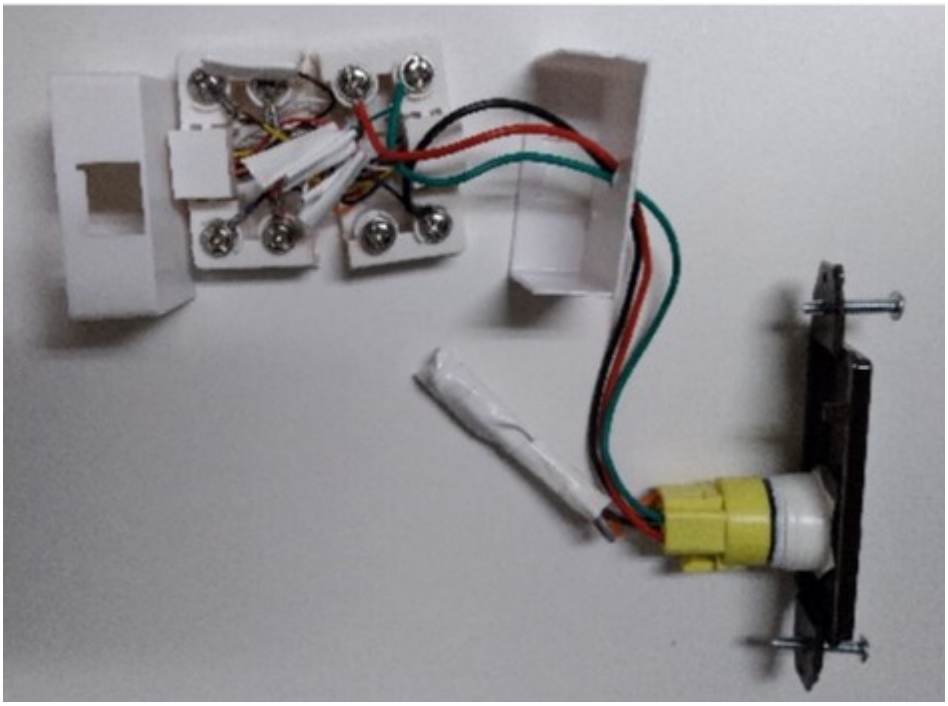
Attic entrance, chassis of resistor for red LEDs:
(The resistor [1W so it has large enough leads] sticks out of the Wago 221 series connectors, so I made a cage out of wire to give it some air room to convert the electricity to heat; the Wagos have a hole in the bottom for insertion of a multimeter probe, which I left uncovered, so heat can escape.)



Bottom of Wagos that have the resistor for the red LEDs, as well as the related jumper wires:



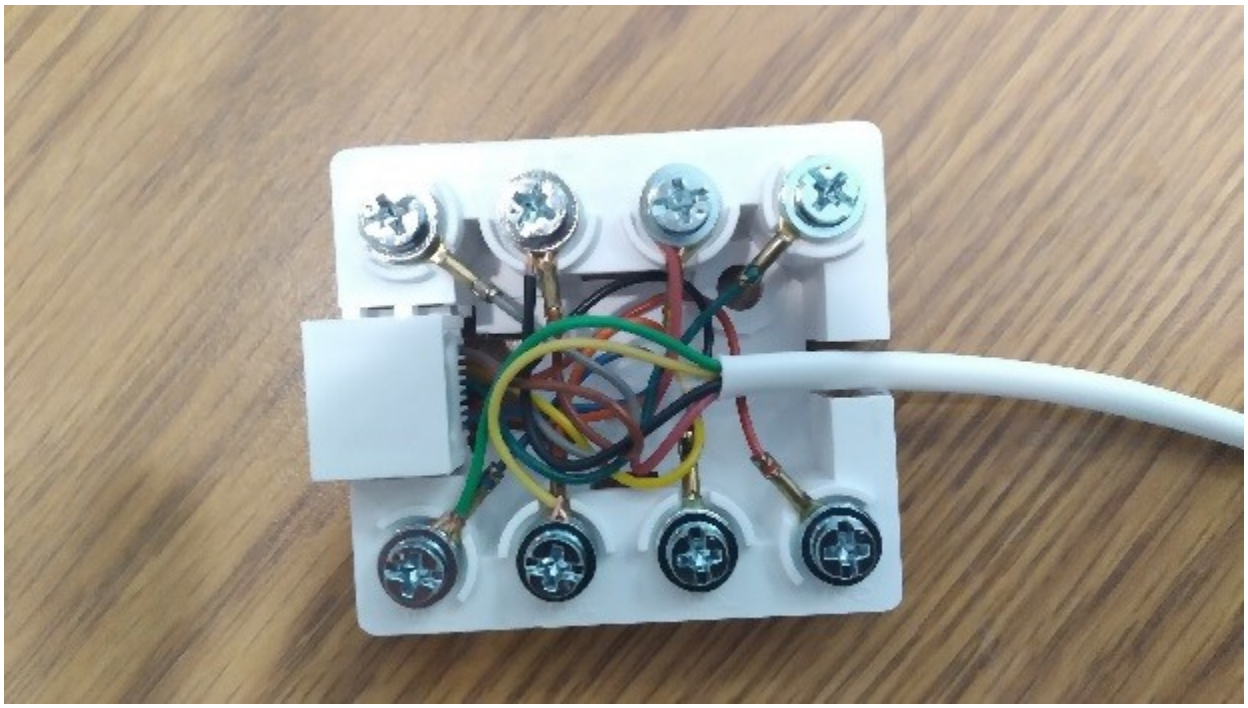
Pulpit/podium splice:
(I wrapped the threads, behind the nut, on the Filn 22mm momentary switch, with PTFE tape that plumbers use, so it would fill the threads, so the nut couldn't back out, and then covered that PTFE tape with electrical tape. This image shows the two 8P8C boxes which have been cut in half, with only the halves that have the female RJ-45 jack remaining, which get used for the 8 screw terminals.)



Pulpit/podium splice boxes (halves) taped together:



Bishop’s pedestal splice (showing 4 conductor cable):



Bishop’s pedestal install:
(A ¾” x 2” [approx.] piece of metal was needed to hold the toggle switch, and holes were drilled so that the XLR insert top screw, that holds the insert to the electrical box, would also hold that piece of metal; the XLR insert also has a lip that prevents that piece of metal from turning. Another hole was drilled above that, to let the bordering decora wall plate, which screws into the XLR insert, be able to protrude without running into that piece of metal. A metal box was used because its screw holes are above it, rather than below, giving room for the switch above it, without having to carve into the electrical box. I did shave out a little of the electrical box where the neck of the insert seats into it, as it was ever so slightly too small: I just rotated a drill bit in those corners. I used an electrical box old work clip on one side of the electrical box, to keep it from being able to be pulled out (such as from some user pulling the toggle switch towards them), and I used a screw on the other side, since those clips would have ran into the switch on the switch side. The white cable is the 4 conductor wire that connects to the switch. The Ethernet comes in through the top knockout of the electrical box, and the XLR wires [black] and the switch leads go out the rear knockout. The 8P8C Cat/Ethernet surface mount box is on the side opposite the switch because the XLR insert sticks out deeper on the switch side, so the Wagos are on that side. The switch was put through the decora wall plate so that it could be removed and covered with a new wall plate, if it was hated; if doing a similar install in another building, getting approval to just drill your own hole in the pedestal, and using a DPDT latching push button switch without illuminating LEDs [from Digikey or Mouser, with appropriate other specs {no internal resistor, ip rated, actuator/cap color, minimum actuations life, etc.}] would be a vastly easier install, and you could just put the Zoom On/Off sticker on the momentary push button switch.)



Sourcing info/links (this is what I used [mostly], though it could be improved upon):

Walmart:

- Cooling Grid ($3.97)(https://www.walmart.com/ip/Wilton-Bake-It-Better-Cooling-Grid-16-x-10-Inch/44432740); I didn't use wire ties much on the cooling rack, since they have metal inside, and it could cause short circuits if it digs into wire jackets, etc., since the cooling rack is metal, and the A/V cabinet chassis is metal, etc., hence I preferred zip ties to connect things to the cooling rack; I also put electrical tape on the feet of the cooling rack to prevent scratching up the A/V cabinet chassis;

Digikey:

- Wago 221-412 (x4)
- Wago 221-413/VE00-2500 (x2=$1.50)
- CFR100JT-52-2K7 ($0.56): 2.7k ohm, 5%, 1W, axial, carbon film resistor (or you could do a better calculation that I originally did: the circuit for the green LEDs is 1.31mA and the circuit for the red LEDs is 2.78mA, so a higher ohm resistor [for the red LEDs] could have been used; keep in mind that the green LED is 1.4x more luminous than the red, so if the circuit for the green LEDs is at 1.31mA you might shoot for getting a resistor for the circuit of the red LEDs that approaches 1.834mA ideally, for similar brightness; the circuit is a combination circuit using parallel and series).
- S6AW-WL ($30.64) NKK toggle switch (ip67, wire leads, 25,000 electrical actuations minimum, 50,000 mechanical actuations minimum); I wouldn't go for a switch less than 25,000 actuations, if you want it to last 20 years, at max usage of each local unit streaming each week

[and no kids playing with it during the week or otherwise]; however, the electricity going through the switch is far below its rated ability, hence it should far outperform the electrical minimum life expectancy; also the ip67 protects the switch life from being immediately suspect, supposing water gets spilled on it as from a sacrament tray or beverage;

Amazon

- (https://a.co/d/8OomShv): C2G HDMI power isolator & injector; USB powered; quantity of 1; $14.98;
- (https://a.co/d/4cqCO6I): Plantronics 5V AC/DC power adapter (conforming to UL/IEC/CSA 62368-1); quantity of 1; $8.19; it powers the C2G HDMI power isolator/injector;
- (https://a.co/d/byUqZ8U); Electric outlet socket plug covers (for unused ports on IOT relay, so things have limited ports available to get wrongly plugged into, if ever unplugged); quantity of 1; $1.79;
- (https://a.co/d/67jrTl6): HDMI male to male coupler; quantity of 1; (which comes with 2); $7.99;
- (https://a.co/d/hympsUf): HDMI 2.0 repeater (which is an HDMI distribution amplifier with no EDID support other than passthrough of EDID, thus it shouldn't introduce extra delay when turning the Zoom On/Off switch back on); quantity of 1; $36.10 including tax and shipping;
- (https://a.co/d/0dQlLAy): 3M/Scotch Extreme Mounting Tape; 12lb, 8 strips; package quantity of 1; $5.24; $5.65 at Walmart; I used it to attach a label to the attic entrance Zoom On/Off switch;
- (https://www.amazon.com/gp/product/B0B5XG3Z32/ref=ppx_yo_dt_b_asin_title_o00_s00?ie=UTF8&psc=1) Filn, 19mm, red and green LED, latching switch, 12V, black actuator/cap, ip rated; it should come with a harness/wiring connector with leads [if purchasing from cnfiln.com, order that harness/wiring connector separately]; (check the options selected in Amazon, as it can redirect if those exact specs are out of stock)
- (https://www.amazon.com/dp/B000P1QJXQ?psc=1&ref=ppx_yo2ov_dt_b_product_details) Bits Limited SCG-3MVR Smart Strip, 5th generation with black face;
- (https://www.amazon.com/dp/B003AVLT9C?psc=1&ref=ppx_yo2ov_dt_b_product_details) Leviton brown insert (or ivory version: https://www.amazon.com/dp/B000F9XC56?psc=1&ref=ppx_yo2ov_dt_b_product_details)
- (https://www.amazon.com/dp/B00PSMUDJ8?psc=1&ref=ppx_yo2ov_dt_b_product_details) Pass & Seymour brown decora TP26 wall plate (or ivory version: https://www.amazon.com/dp/B0001M6FQU?psc=1&ref=ppx_yo2ov_dt_b_product_details)
- (https://www.amazon.com/dp/B0B5XKBY3F?ref=ppx_yo2ov_dt_b_product_details&th=1) Filn, 22mm, red and green LEDs, 12V, momentary switch, black actuator/cap, ip rated; it should come with a harness/wiring connector with leads [if purchasing from cnfiln.com, order that harness/wiring connector separately]; (check the options selected in Amazon, as it can redirect if those exact specs are out of stock)

Lowes:

- (https://www.lowes.com/pd/Southwire-20-2-Twisted-Doorbell-Wire-By-the-Foot/3378620?cm_mmc=shp-_-c-_-prd-_-elc-_-ggl-_-LIA_ELC_106_Tools-Wire-Connectors-_-3378620-_-local-_-0-_-0&gclid=EAIaIQobChMInr7vm7T4_gIVtADnCh0hAgxtEAQYBSABEgKY7fD_BwE&gclsrc

=aw.ds)(or cut 1 ft. in store [$0.28/ft.]): Southwire twisted doorbell wire, 20 AWG (NOT 18 AWG), solid, unattached red and white, for jumper wire between connectors, if you want this option; quantity of ‘6’ft. minimum online;

- (https://www.lowes.com/pd/Southwire-1-ft-22-4-Solid-White-Security-Cable/4284059?cm_mmc=shp-_-c-_-prd-_-elc-_-ggl-_-LIA_ELC_106_Tools-Wire-Connectors-_-4284059-_-local-_-0-_-0&gclid=EAIaIQobChMI862OpMH__gIV2SCtBh1vwgU6EAQYBiABEgJWm_D_BwE&gclsrc=aw.ds)(or cut 3 ft. in store [$0.36/ft.]): 4 conductor 22 AWG solid bare copper [jacketed]; you can also pull out the inner wires from the shared jacket, leaving them unstripped/jacketed, and cut them as needed to try them as wire ties to hold on labels for other things; quantity of ‘6’ft. minimum online; it’s CMR
- 2 conductor 18 AWG barostat wire, by the foot, for jumper wire; it’s CL2;
- (https://www.lowes.com/pd/Scotch-35-White-66-ft/50109016): Scotch 35 white electrical tape for labeling, pulling wire, and for splices; quantity of 1; $6.98;
- PTFE/Teflon tape; quantity of 1 roll; should be about $1 in a hardware store;
- #10 screw cover (black rubber, for toggle switch; comes in a pack of 2, and is found in the trays in the hardware section);

Adafruit.com:

- (https://www.adafruit.com/product/2230): 94 x 83 x 30mm box/enclosure [for push button switch]; it’s actually 90 x 82 x 26mm; quantity of 1; $5.95;
- (https://www.adafruit.com/product/2935)($34.95)(or alternately [https://dlidirect.com/collections/frontpage/products/iot-power-relay]): Digital Loggers IOT Relay v.2; quantity of 1; $29.95 + tax, though separate shipping; non-solid-state relays generally require a lot of power, so a solid-state component like a BJT or mosfet is oftentimes used in conjuction, to lower the power requirement, and such solid-state components often require a handful of other components to protect and help them: the IOT relay was a user-friendly option that includes such (it uses a BJT because it is less sensitive to transients than a fet);

Home Depot:

- Ethernet cable, CMR or CMP, depending on the route you take;
- Southwire PL500 Ligne Poly Line 210lb tensile strength, 500 ft, if pulling wire;
- RJ-45 male connectors;
- Tripp-Lite 6ft HDMI extension cord (male to female, for Extron to C2G HDMI power isolator/injector connection); online purchase;
- Leviton 8p8c surface mount boxes (x4); Model #102-40278-00W; Internet #301750633;
- Steel City 3.5” deep metal electrical box (remove the wire clamps at the back of the interior);
- electrical box old work clip (to keep it from being pulled out of the wall); you’ll need a screw for the other side;
- black zip ties (2 sizes are helpful);

Monoprice (via Monoprice, Amazon, or Target):

- 6ft HDMI cable (for HDMI OUT of the HDMI repeater, to the computer capture card);

Source wherever:

- ‘HELLO, MY NAME IS’ label stickers: I used a glue stick to connect the label at the pulpit/podium to it, then laminated it, then cut out the label perimeter and the switch/indicator light hole, then peeled off the back lamination and back of the sticker, and put it on the Leviton brown insert, and put the 22mm filn momentary switch and indicator over it, so it’s flange covers the hole cut out in the label);
- 12V power adapter, CL2 or ITE rated (UL/IEC/CSA 62368-1); it powers the circuit for the switches and LEDs and such;
- metal strip (~¾” x ~2”);

Tools that will likely be useful (you can probably borrow all of them, as needed):

- fishing tape (fiberglass/carbon fiber is preferred for installs with existing cables; if using steel, be delicate; alternately have FM group run the Ethernet wires for you, if they will);
- screw drivers;
- wire cutters (and to cut up 8p8c box tops: put in all the way, press so as to crease, not cut, pull back and press harder, pull back and press hard enough to cut, and it will follow the crease);
- RJ-45 male crimpers;
- saw (to split 8p8c box’s bottoms);
- 7/8” drill bit (for plastic);
- 3/4” drill bit (for metal);
- assortment of small drill bits (for metal);
- multimeter;
- color printer;
- glue stick;
- laminator (sometimes there is one in the materials center of the meetinghouse);
- Label maker (Dymo, or P-touch; there might be one in a Clerks Office, or borrow one from someone crafty): white tape and black letters (for labeling the Zoom On/Off tech on the cooling rack, and related cable ends, as to where they go, etc.);
- pen/marker to label 8P8C Cat/Ethernet surface mount boxes, and white electrical tape on Ethernet ends, etc.;