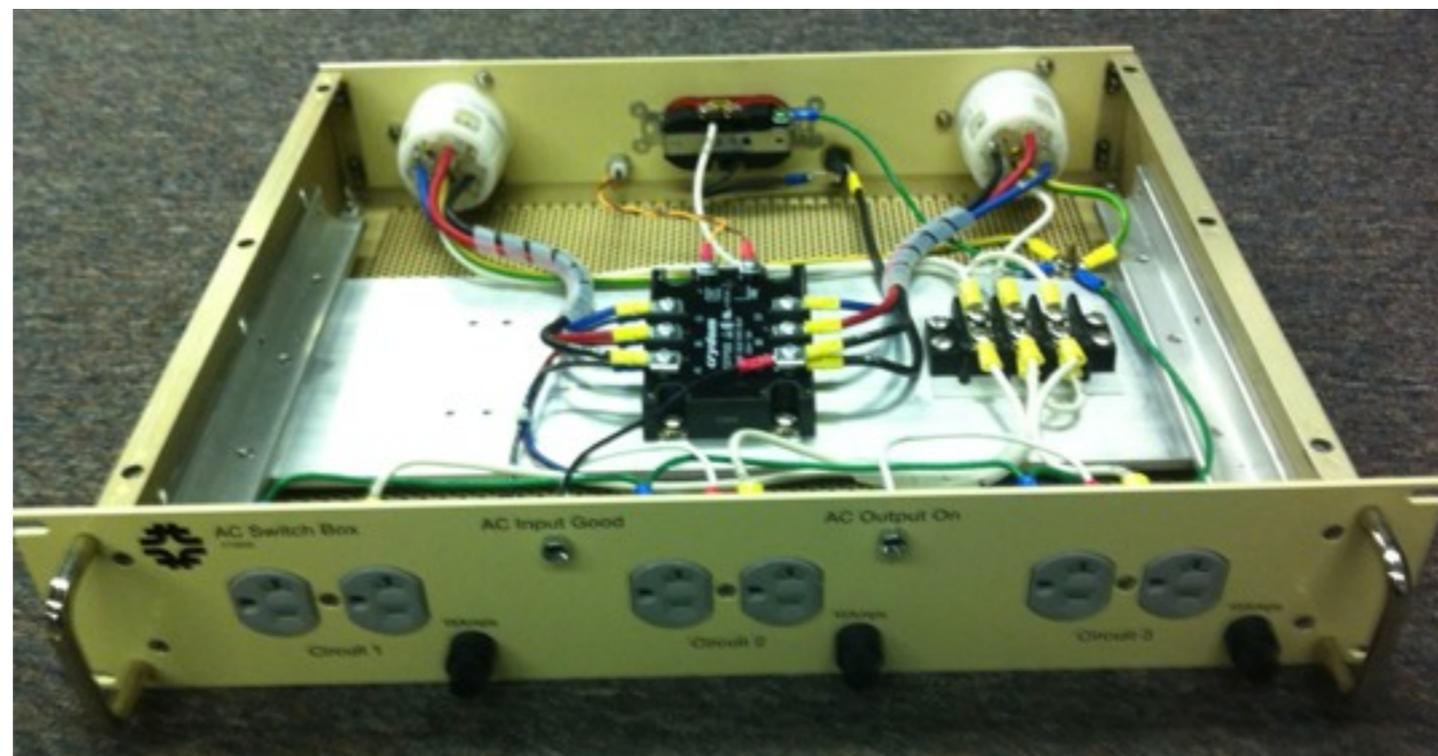

How to Build an AC Switch Box

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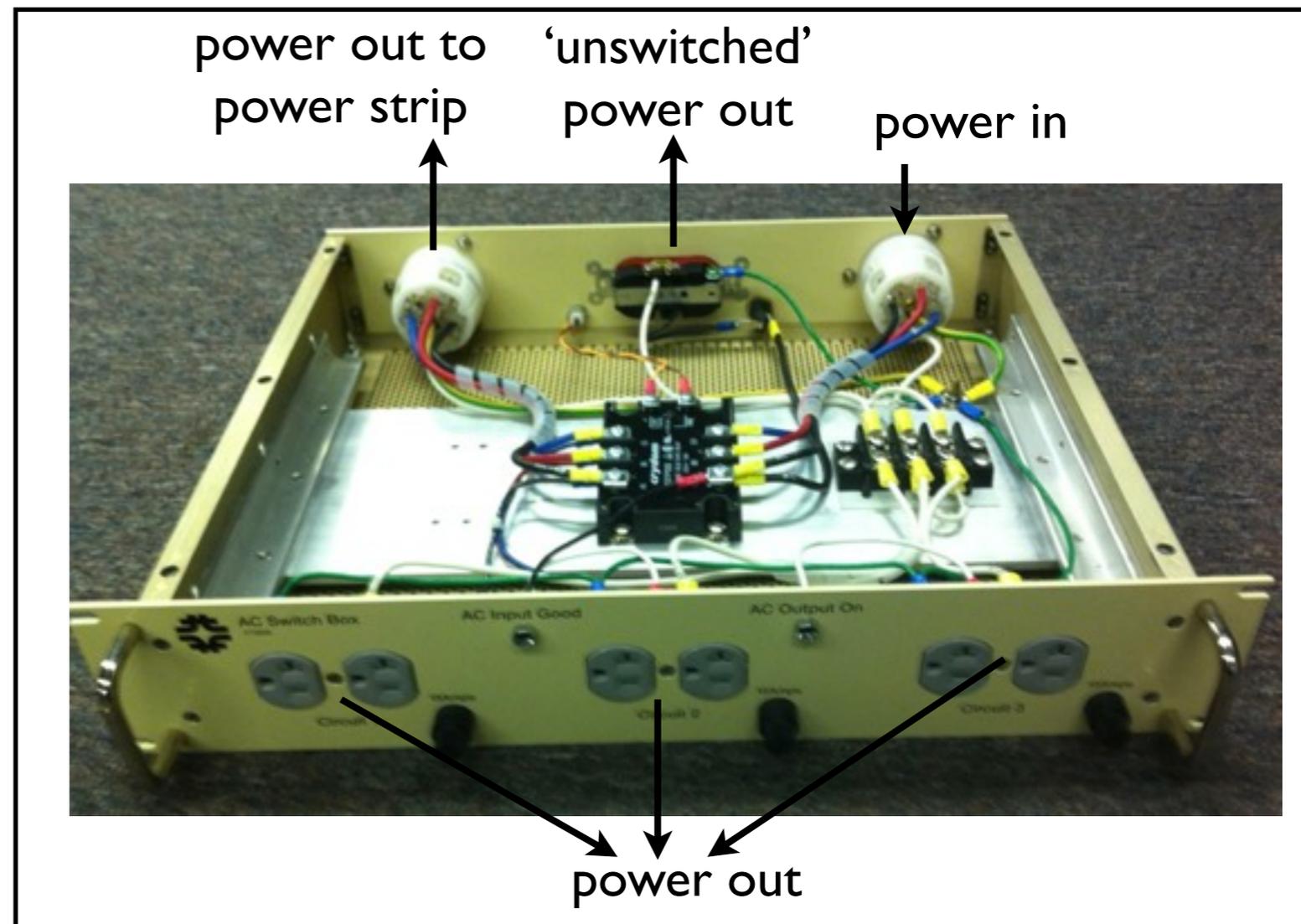
What is an AC Switch Box?



- The AC Switch Box provides clean AC power to all the electronics in a rack
- If the rack smoke detector has gone off or is not connected, the AC Switch box will automatically cease to provide power to rack components.
 - One 'unswitched' receptacle will continue to output power in this case
- Two different types:
 - standard box, pictured here
 - 'special' box: very similar



Box back and top

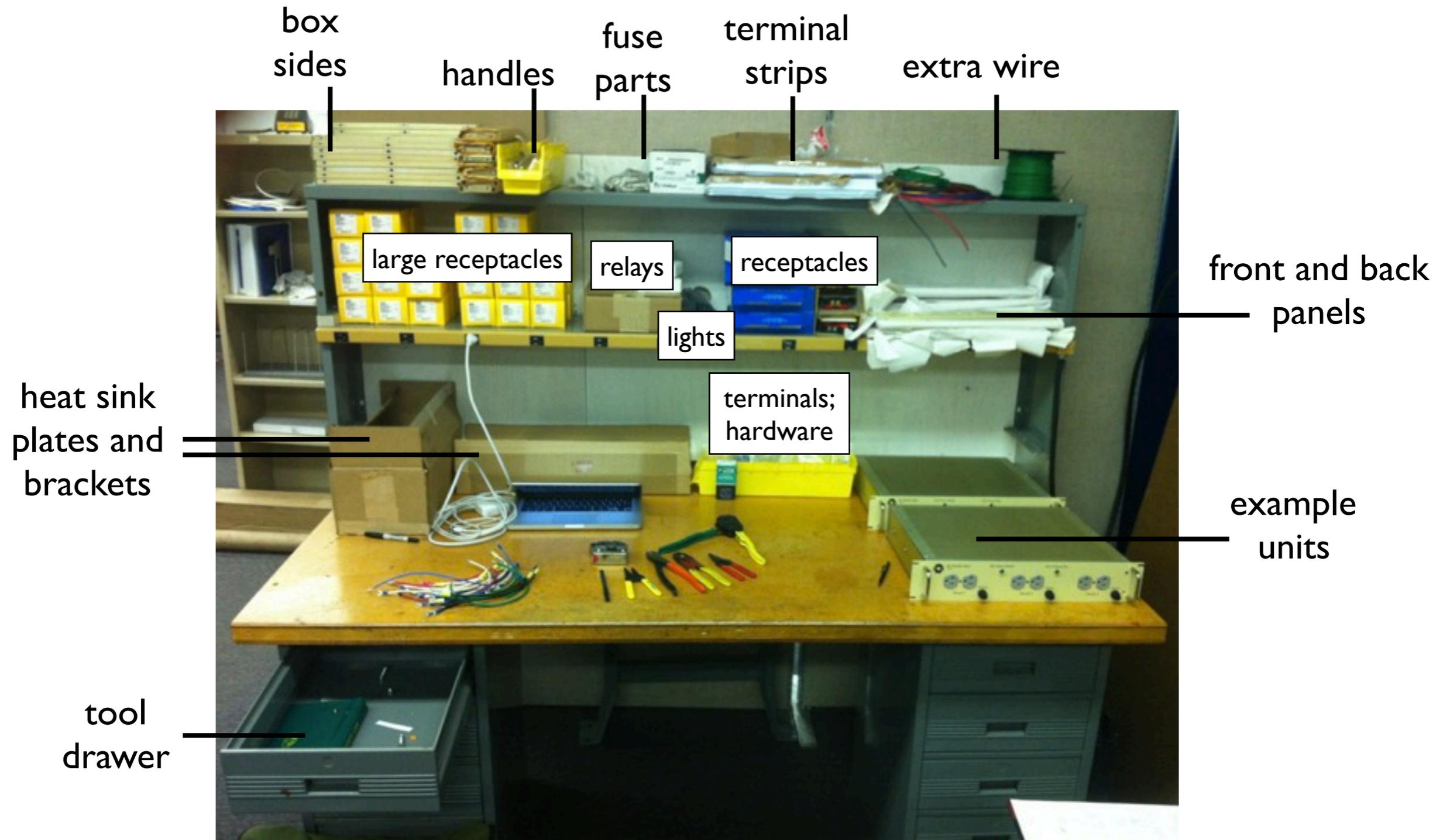


Box front and top, uncovered

AC Switch Box Station



- Here is a tour of where you will build it:



Construction Steps



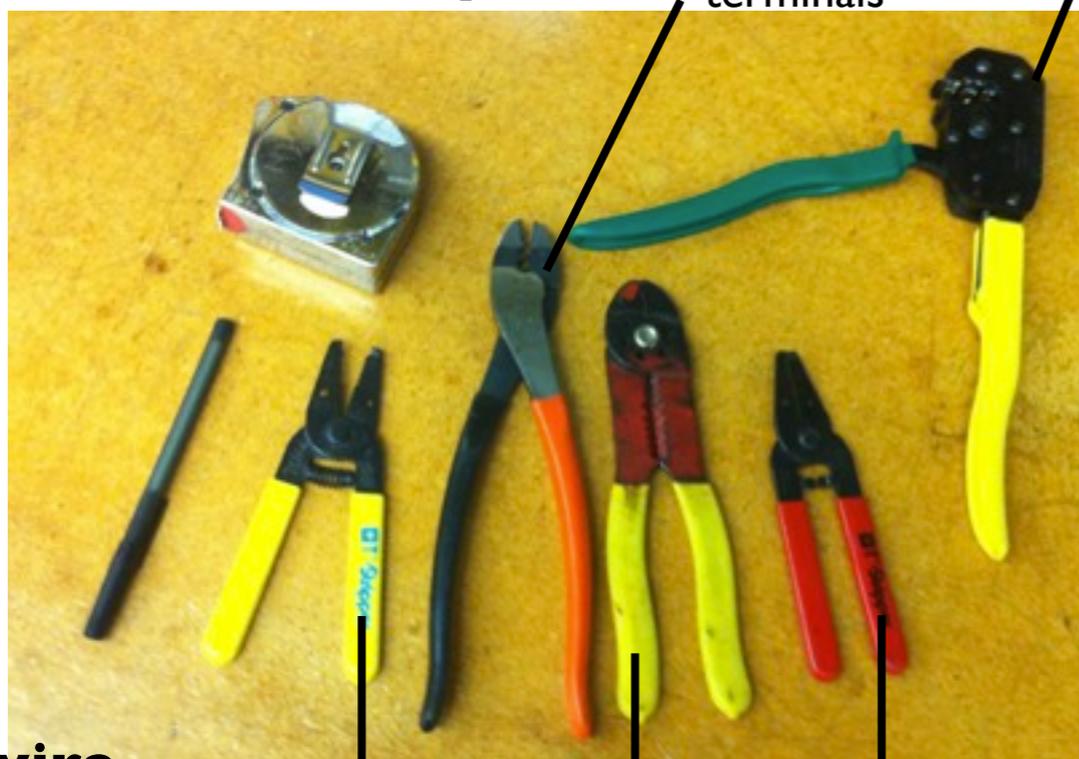
- Here are the general building steps:
 1. Build the wires
 2. Construct and wire the front and back panels
 3. Construct the relay area
 4. Connect box
 5. Wire the relay area
 6. Attach bottom panel

Pretty simple, right?

Rest of the talk will outline each of these steps

1: Build Wires

- **Tools: crimpers** for uninsulated terminals for insulated terminals



wire strippers

for 22-30 gauge wires

for 10-22 gauge wire

for 16-26 gauge wire

Use stripper slot that matches wire gauge!!

- **Materials:**

Closer pictures appear on next page
Wire gauge is labelled on wire!!!

Larger gauge = thinner!

Terminals

for 10-12 gauge wire

for 14-16 gauge wire

for 18-22 gauge wire

Wire

10, 14, and 22 gauge (AWG); various colors



Finished Product

1: Build Wires

- Follow these recipes to make 10 AWG wires:

- NOTE: BUILD FOR SPECIAL BOXES IS SLIGHTLY DIFFERENT; beware!
- Crimp ends with green/yellow crimper; if uninsulated used orange/black crimper
- Follow color-coding on the crimper! It matches terminal color (10 AWG = yellow)!

Cable #	Description	Hardware	End 1	Color/Ga	Length	End 2	Hardware
AC101	AC Input to SSR	Stripped 1/2"		Black/10	9.75"		#10 Fork Tongue 10AWG
AC102	AC Input to SSR	Stripped 1/2"		Red/10	10"		#10 Fork Tongue 10AWG
AC103	AC Input to SSR	Stripped 1/2"		Blue/10	10.5"		#10 Fork Tongue 10AWG
AC104	AC Input to Neutral Block	Stripped 1/2"		White/10	6.5"		#10 Fork Tongue 10AWG
AC105	SSR to AC Output X	Stripped 1/2"		Black/10	9.75"		#10 Fork Tongue 10AWG
AC106	SSR to AC Output Y	Stripped 1/2"		Red/10	10"		#10 Fork Tongue 10AWG
AC107	SSR to AC Output Z	Stripped 1/2"		Blue/10	10.5"		#10 Fork Tongue 10AWG
AC108	AC Output to Neutral Block	Stripped 1/2"		White/10	14.5"		#10 Fork Tongue 10AWG
AC109	AC Input Ground	Stripped 1/2"		Green/10	5.5"		#10 Ring Tongue 10AWG
AC110	AC Output Ground	Stripped 1/2"		Green/10	16"		#10 Ring Tongue 10AWG
AC123	Neutral Jumper 1	#10 Fork Tongue 10AWG		White/10	4"		#10 Fork Tongue 10AWG
AC124	Neutral Jumper 2	#10 Fork Tongue 10AWG		White/10	4"		#10 Fork Tongue 10AWG
AC129	Fuse to SSR A2	Quick Connect 1/4" x 30mil		Black/10	10"		#10 Ring Tongue 10AWG

Not needed for special boxes!

16" for special boxes!

- If you run out of wire, more is available next door

1: Build Wires: Standard Boxes



- Follow these recipes to make 14, 22 AWG wires:
 - Follow color-coding on the crimper! It matches terminal color!

Cable #	Description	Hardware	End 1	Color/Ga	Length	End 2	Hardware
AC111	Circuit 1 Neutral	#8 Fork Tongue 14AWG		White/14	14"		#10 Fork Tongue 14AWG
AC112	Circuit 2 Neutral	#8 Fork Tongue 10AWG		White/14	9"		#10 Fork Tongue 14AWG
AC113	Circuit 3 Neutral	#8 Fork Tongue 10AWG		White/14	6"		#10 Fork Tongue 14AWG
AC114	Un-Switched Neutral	Stripped 1/2"		White/14	11"		#10 Fork Tongue 14AWG
AC115	SSR Out to Fuse Circuit 1	#10 Fork Tongue 14AWG		Black/14	7"		Quick Connect 1/4" x 30mil
AC116	SSR Out to Fuse Circuit 2	#10 Fork Tongue 14AWG		Red/14	11.5"		Quick Connect 1/4" x 30mil
AC117	SSR Out to Fuse Circuit 3	#10 Fork Tongue 14AWG		Blue/14	18"		Quick Connect 1/4" x 30mil
AC118	Fuse to Duplex Circuit 1	Quick Connect 1/4" x 30mil		Black/14	5"		#8 Fork Tongue 14AWG
AC119	Fuse to Duplex Circuit 2	Quick Connect 1/4" x 30mil		Red/14	5"		#8 Fork Tongue 14AWG
AC120	Fuse to Duplex Circuit 3	Quick Connect 1/4" x 30mil		Blue/14	5"		#8 Fork Tongue 14AWG
AC121	BNC to SSR Control +	Stripped 1/4"		Orange/22	7.5"		#6 Fork Tongue 22AWG
AC122	BNC to SSR Control -	Stripped 1/4"		Brown/22	7.5"		#6 Fork Tongue 22AWG
AC125	Ground Circuit 1 to 2	#8 Fork Tongue 14AWG		Green/14	8"		#8 Fork Tongue 14AWG
AC126	Ground Circuit 2 to 3	#8 Fork Tongue 14AWG		Green/14	8"		#8 Fork Tongue 14AWG
AC127	Ground Circuit 3 to stud	#8 Fork Tongue 14AWG		Green/14	11"		#10 Ring Tongue 14AWG
AC128	Un-Switched Hot to Fuse	Stripped 1/2"		Black/14	5"		Quick Connect 1/4" x 30mil
AC125	Ground Circuit 1 to 2	#8 Fork Tongue 14AWG		Green/14	10"		#8 Fork Tongue 14AWG

1: Build Wires: Special Boxes



- Additional 'special box' 14 AWG wires:

Cable #	Description	Hardware	End 1	Color/Ga	Length	End 2	Hardware
AC125	Ground Circuit 1 to 2	#8 Fork Tongue 14AWG		Green/14	8"		#8 Fork Tongue 14AWG
AC125	Ground Circuit 1 to 2	#8 Fork Tongue 14AWG		Green/14	8"		#8 Fork Tongue 14AWG
AC119	Fuse to Duplex Circuit 2	Quick Connect 1/4" x 30mil		Red/14	5"		#8 Fork Tongue 14AWG
AC120	Fuse to Duplex Circuit 3	Quick Connect 1/4" x 30mil		Blue/14	5"		#8 Fork Tongue 14AWG
AC111	Circuit 1 Neutral	#8 Fork Tongue 14AWG		White/14	14"		#10 Fork Tongue 14AWG
AC113	Circuit 3 Neutral	#8 Fork Tongue 10AWG		White/14	6"		#10 Fork Tongue 14AWG
AC116	SSR Out to Fuse Circuit 2	#10 Fork Tongue 14AWG		Red/14	11.5"		Quick Connect 1/4" x 30mil
AC117	SSR Out to Fuse Circuit 3	#10 Fork Tongue 14AWG		Blue/14	18"		Quick Connect 1/4" x 30mil

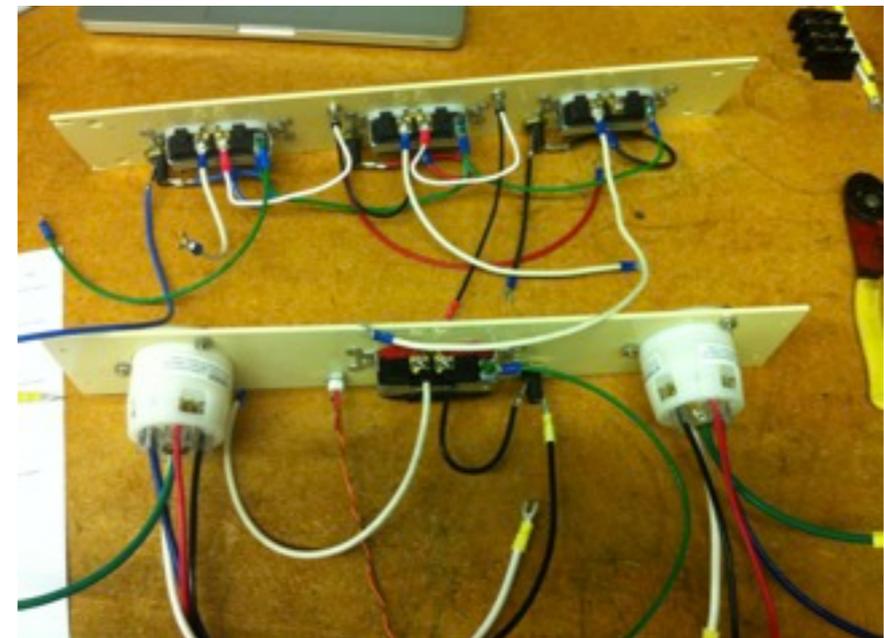
2: Construct/Wire Front/Back Panels



- Screw or connect hardware to front/back panels
 - Follow example of constructed box to find correct screws; if in doubt, see list of materials at the end of these instructions for a complete list of hardware
 - Make sure orientation of part is correct: is receptacle, fuse facing right direction?
 - Make sure to put 15A fuses in the black fuse holders!!



- Connect wires to hardware
 - Follow example of constructed AC Switch boxes to see what goes where
 - Note: 22 AWG wires must be soldered to interlock connector!! Get supervisor for this the first time!!!



3: Construct Relay Area



- Screw heat sink plate to brackets
 - Spread thermal compound where brackets and plate overlap!
- Screw brackets to box sides
 - Spread thermal compound where brackets and sides overlap!
- Screw relay and terminal strip to heat sink plate
 - Spread thermal compound where brackets and plate overlap!

4: Construct Box



- Screw sides to back and front plates
 - Follow example of constructed box to figure out correct screws
- Screw in handles
- Connect bottom perforated sheet

5: Wire Relay Area



- Connect front/back plane wires to relay and barrier strip
 - Follow example of constructed box to figure out correct connections
 - Make sure colors match the example!
 - Be aware of special box or standard box: wirings are different!
- Try to follow cable routing paths from examples
 - Use cable ties to be extra neat
- Connect green grounding wires to grounding post

Extra





List of Materials

For standard AC switch boxes; specials are a bit different

AC Switch Box				
Item #	Comment	Description	Part Number	Quantity
1	L21-30P	NEMA Flanged Plug 30Amp, Hubbell	HBL2815	1
2	L21-30R	NEMA Flanged Receptacle 30Amp, Hubbell	HBL2816	1 0
3	Duplex Receptacle	Receptacle 20Amp, Leviton, Gray	CR20-GY	3 5
4	Duplex Receptacle	Receptacle 20Amp, Hubbell, Red	5352AR	1
5	Solid State Relay	CRYDOM SSR, PANEL MOUNT, 530VAC, 32VDC, 50A	D53TP50D	1
6	Fuse Holder	Fuse Holder, Littelfuse Straight Bottom	03420858H	4 6
7	BNC	Isolated BNC	5227726-2	1
8	Front Panel	Front Panel, Fermi Design	Drawing #173856	1
9	Rear Panel	Rear Panel, Fermi Design	Drawing #173857	1
10	Fuse	15Amp SLO-BLO fuse	0326015.MXP	4? 6
11	Indicator	Pilot Light LED GRN PANEL MOUNT, Lumex	SSI-LXR9126SGD110V	2
12	Top/Bottom	14" x 17" perforated	Fermilab Stock	2
13	Barrier Strip	3 position 50Amp barrier strip	38280-0103(Molex) 603 GP 03(Marathon)	2
14	Marker Strip	Marker/Insulator Strip, G10		2
15	SSR Heat Sink	Relay Heatsink	Drawing # 173862	1
16	Heat Sink Mounting Bracket	Heatsink Mounting Bracket	Drawing # 173863	2
17	Handles	2U	Fermilab Stock	2
18	Side Panels	3" high	Fermilab Stock	2
19	SO cord	36" 5-wire 10AWG		1
20	Plug	L21-30P Cord End	HUBBELL P/N 2811 30A., 120/208V	1
21	Receptacle	L21-30R Cord End	HUBBELL P/N 2813 30A., 120/208V	1
AC Chassis Hardware				
22	Heatsink Bracket	1/4-20 x 1/2" SS Pan Head		6
23	Ground Stud Nut	10-32 Nut with Captured Star Washer		1
24	Ground Stud	10-32 x 1" SS Pan Head		1
25	Handle Screws	10-32 x 1/2" Flat Heat		4
26	Terminal Strip Mounting	10-32 x 3/4" SS Pan Head		4?
27	SSR mounting screws	10-32 x 3/8" SS Pan Head		4
28	Heatsink Bracket to side	10-32 x 3/8" SS Pan Head		6
29	Handles	2-1/2" center spacing		2
30	Side Panel to Front	6-32 x 3/8" SS Flat Head		4
31	Duplex Mounting	6-32 x 3/8" SS Oval Head		4 6
32	Side Panel to Back	6-32 x 3/8" SS Pan Head		4
33	Nut w/captured lockwasher	8-32 Nut with Captured Star Washer		6
34	Input/Output mounting	8-32 x 1/4" SS Pan Head		6 3
35	Thermal Pad for SSR	TFlex SF210 0.010" thick 2-7/8" x 4-1/8"	Laird Thermal Products, A16807-01	0.3

