Fachgesprach – 16

DDC Controller Digital Outputs

WTF Philosophy:

If you don't remember a certain formula, That's OK - you can always GoogleTheShit. But bad engineering CONCEPTS costs the Company money.

WTF Institute Mission:

Teach correct engineering CONCEPTS to our PEs and PMs.

By Mat Ansari PE

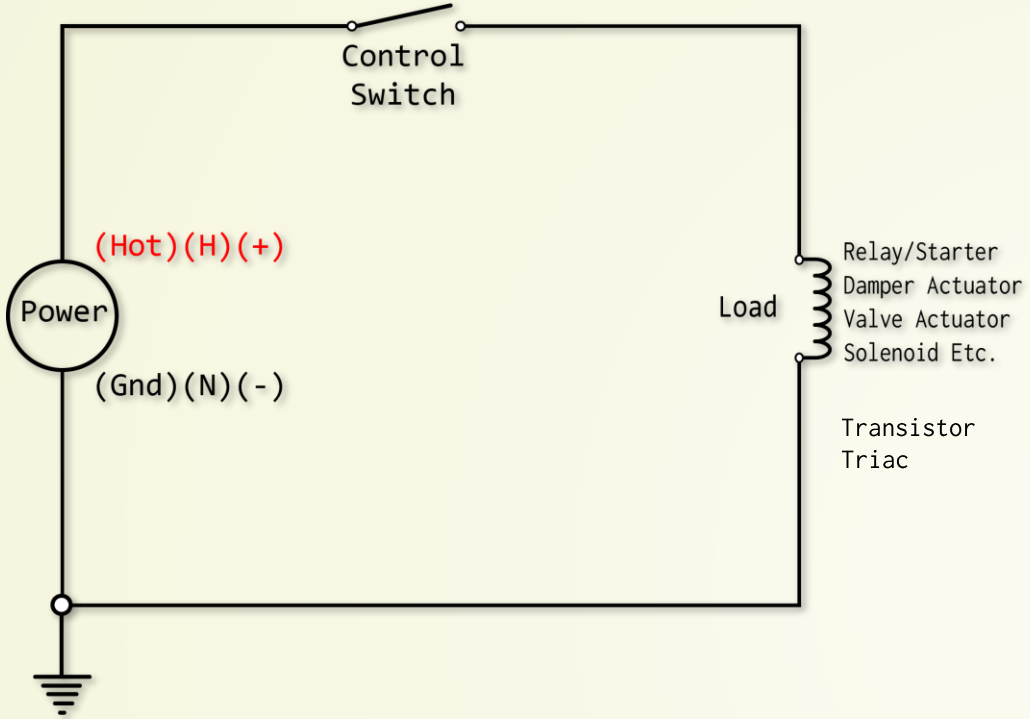
Digital Output

- A Digital Output is a controller output that is either ON or OFF – nothing in between (sometimes called a Binary Output by snootholes who have taken some Boolean Algebra in college)
- BUT
- If that's all there is to it – you could all go home now and not have to sit through some very convoluted shit for the next 45 minutes

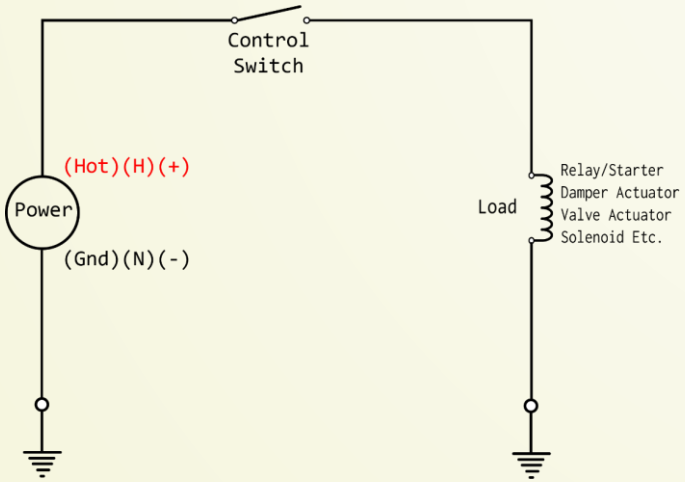
What is the Purpose of this Discussion?

- Not Electronics Technology
- "Layout-Awareness" is my goal
- The slides that follow will show what that means
- And please be patient. The slides may appear to be randomly arranged – but it will all come together

Every DO MUST Form This Simple Loop



Equivalent Circuit



12 Question Checklist – For Good Design

LOAD:

1. What Voltage level/type does it require?
2. How many Amps does it draw? Or VA?

POWER:

3. Where is this Power coming from (Next Slide)? (Only 1 power source in one loop.)
4. Type AC or DC - does it match LOAD?
5. Voltage Level – does it match LOAD?
6. Power source VA sufficient for LOAD?
7. What if there are multiple LOADS?

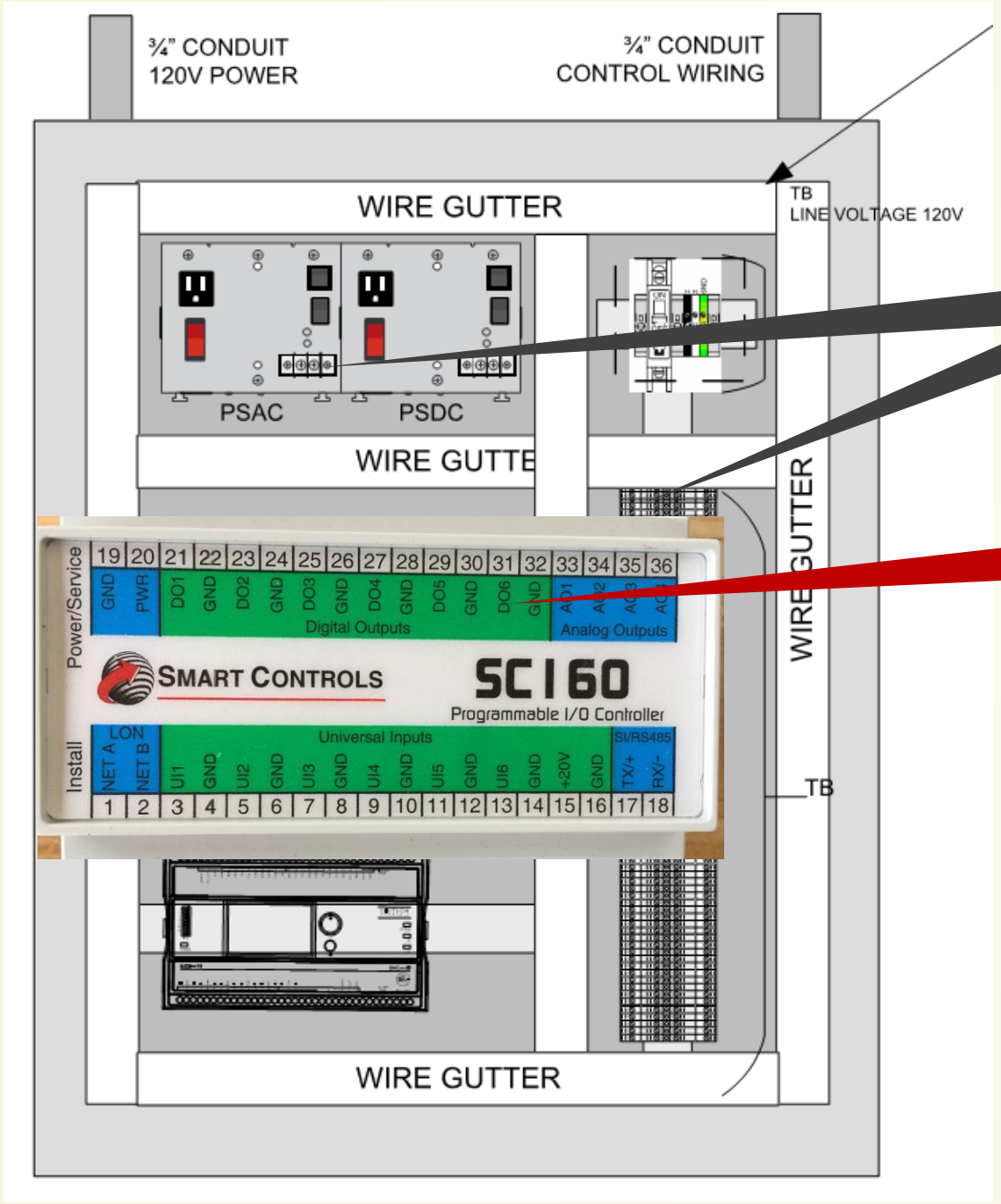
CONTROL SWITCH:

8. Where is it located in the circuit? (May not be as shown on sketch.)
9. What are the Switch Amp and Voltage rating?
10. Can it carry the LOAD Current and Voltage?

SURGE PROTECTION:

11. Required?
12. Built-in?

Power Source For DO



You can get 24Vac here (PS Terminal Block)

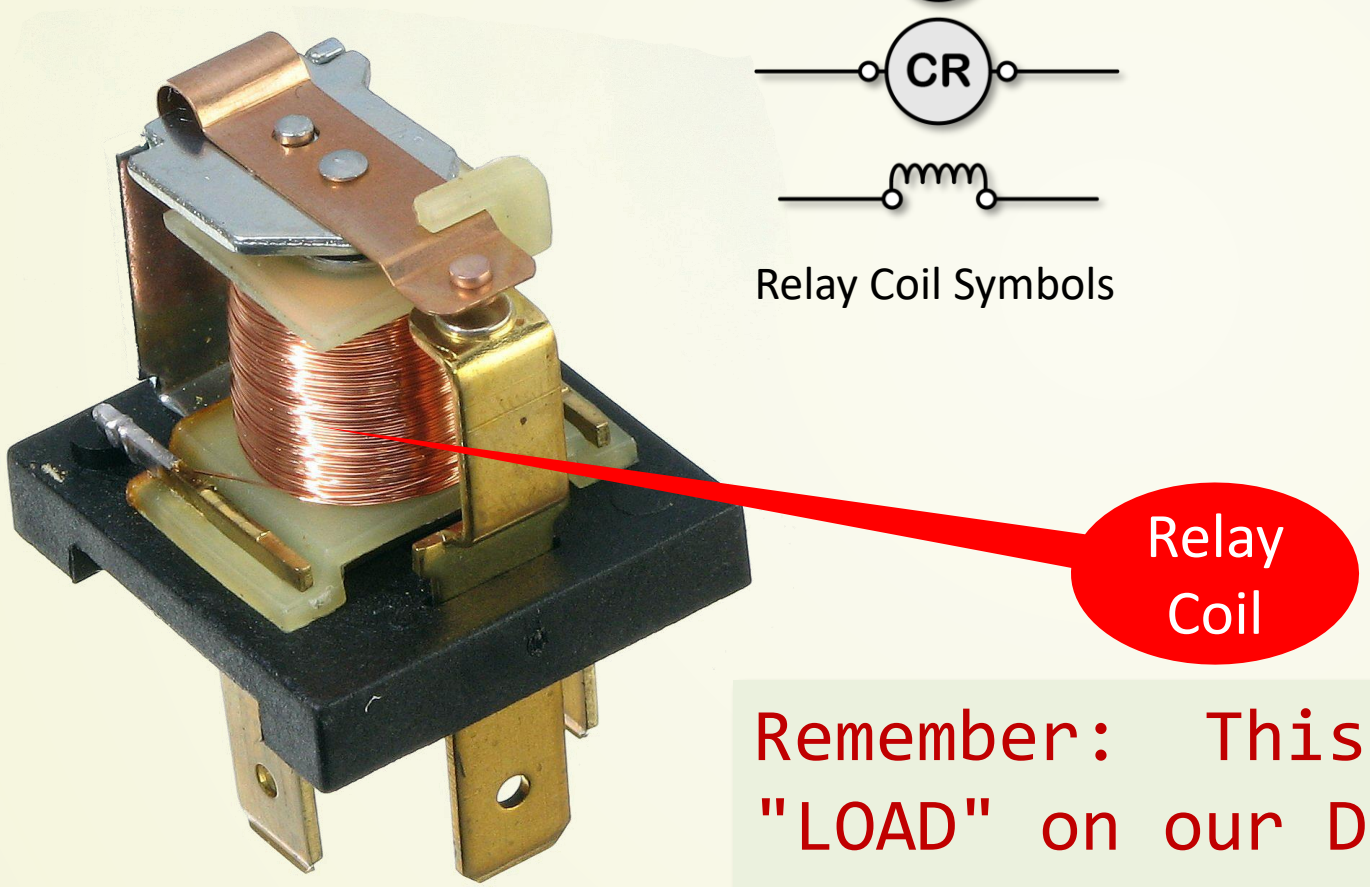
V-dc usually sourced by controllers

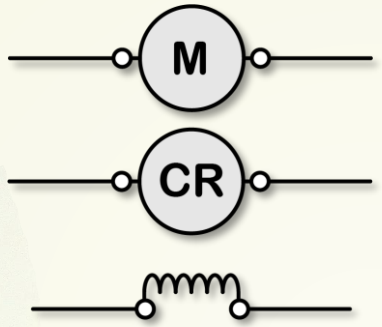
You can get 24Vac here (Sourcing Triacs)

Install new 24 Volt transformer in a box with 120 Volt power and disconnect switch

There is usually a control transformer in the motor starter – if everything matches you can think about using that

The Most Common Load Type On Digital Outputs





Relay Coil Symbols

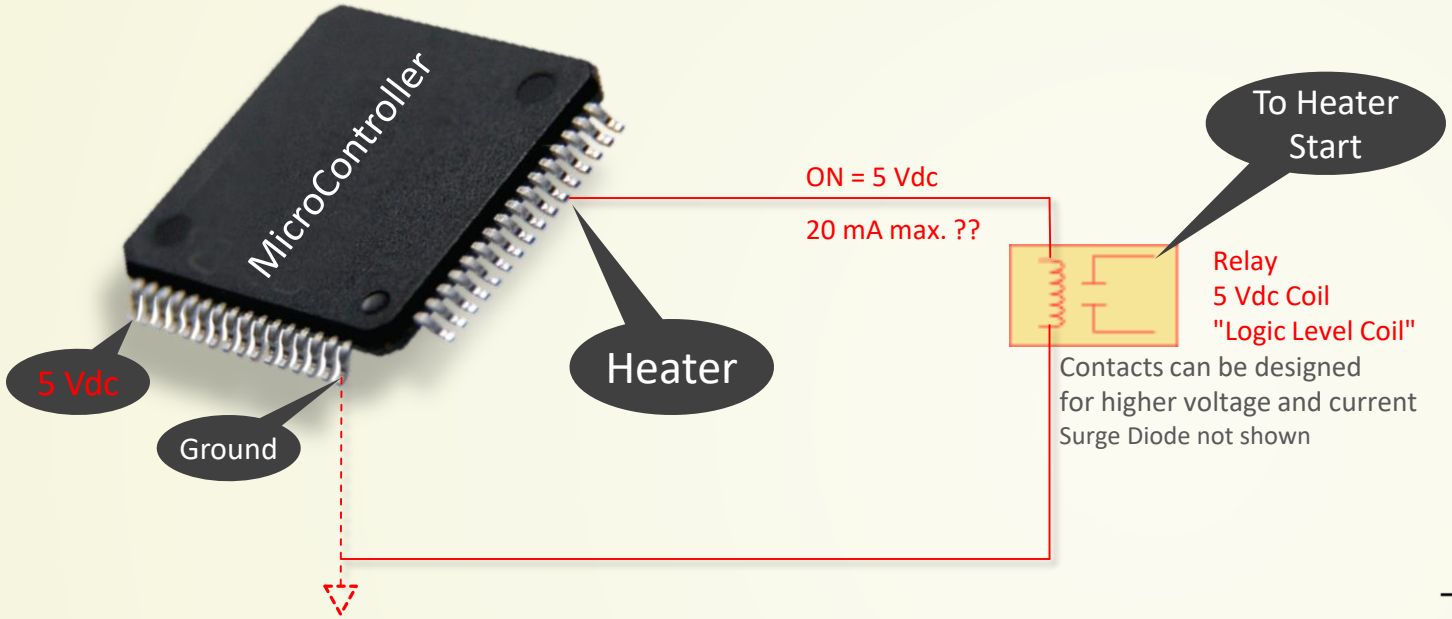
To Power a coil you MUST KNOW:

- AC or DC
- Voltage
- Amp Draw
- AC Inrush
- Kick-back Protection

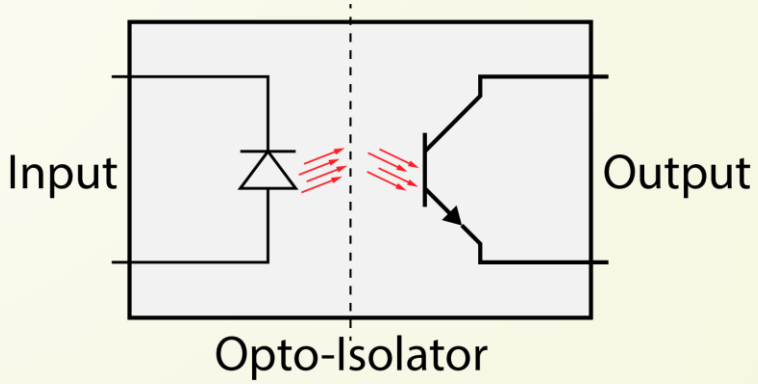
Relay Contacts Ratings and Transient Voltage Suppression will be our next discussion. So we will not discuss it today.

Remember: This coil is the "LOAD" on our Digital Output. A coil is an inductive load.

At The Very Bottom of it all – this happens

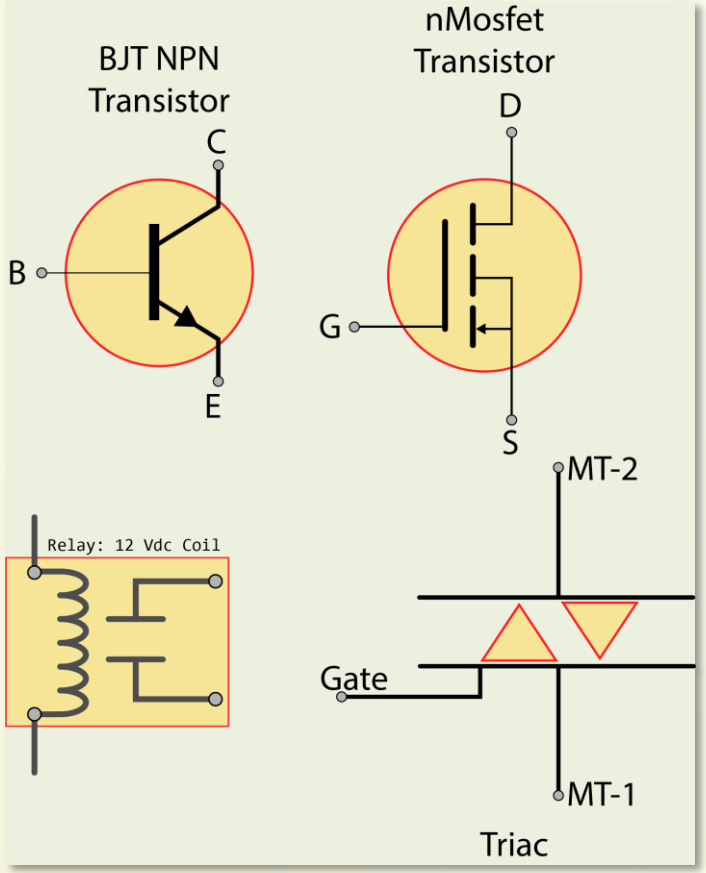


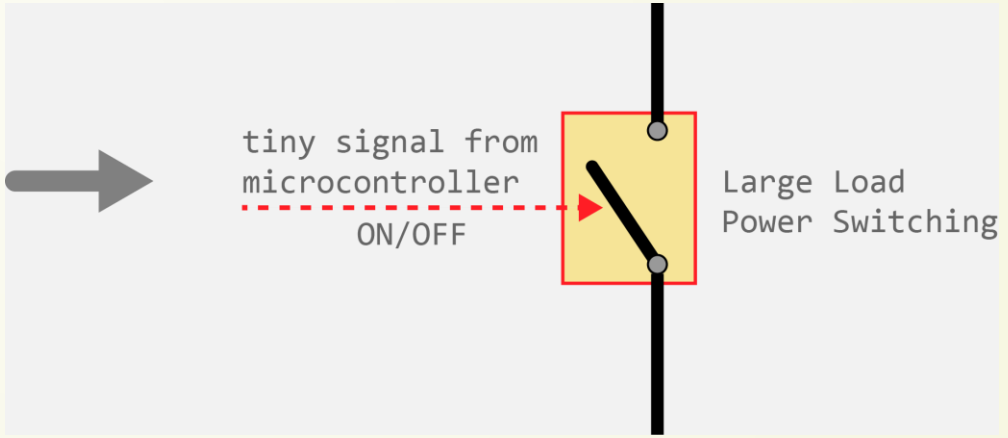

```
Pseudocode:
11 = heater;

If (RoomTemp < 70)
     io_out(heater, ON);   //make this pin high or output 5 volts

Else if(RoomTemp > 73)
     io_out(heater, OFF);   //make this pin low or output 0 volts
```



Electronic Leverage

- Small Current (Voltage) turning ON/OFF large Currents and higher Voltages.





Electronic Leverage

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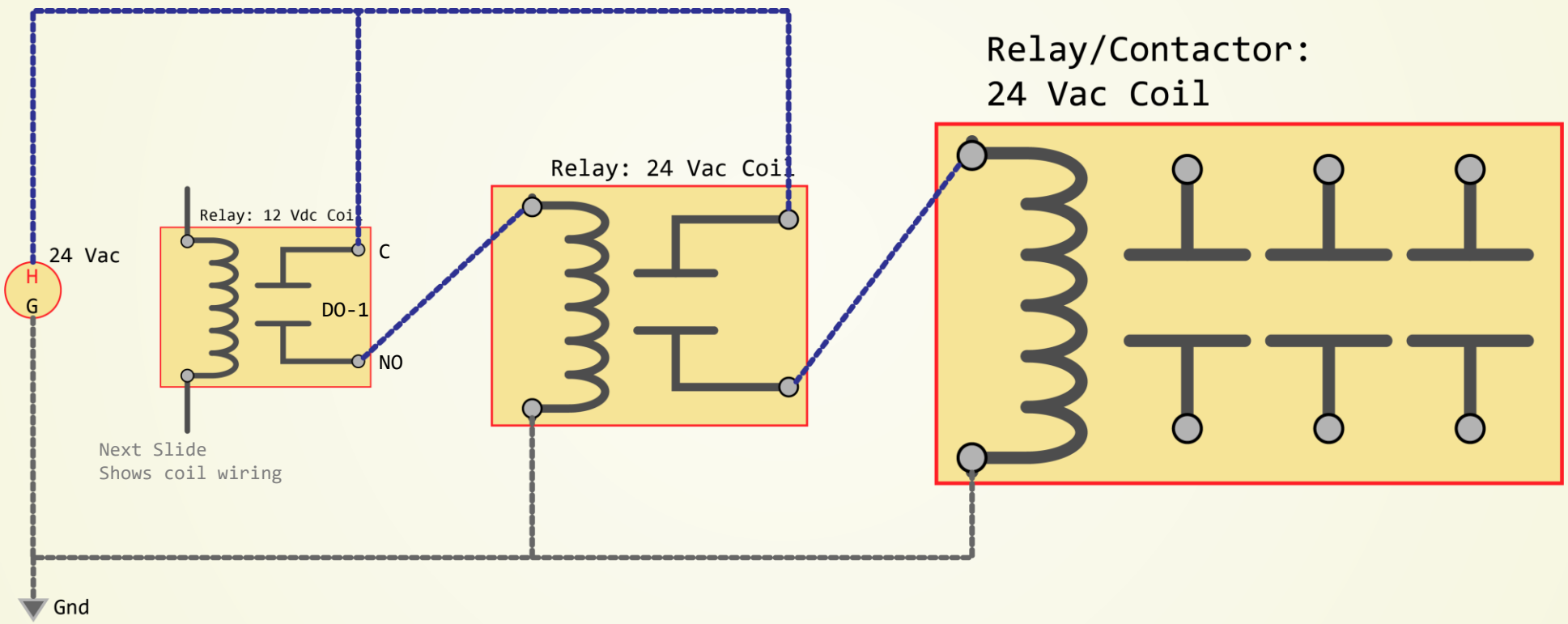
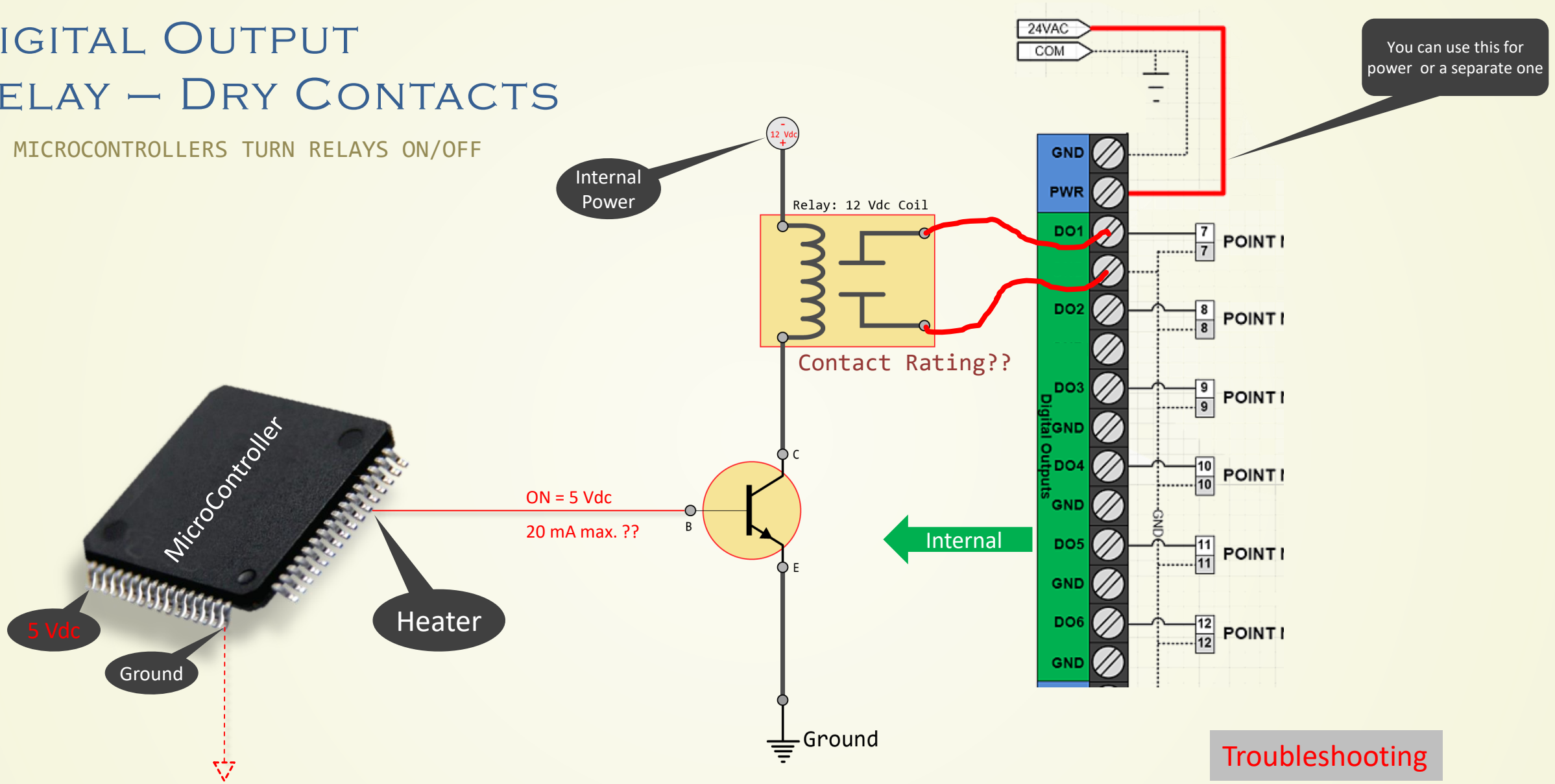


Can we omit the middle relay and go direct to Starter?
Wait till later slides.

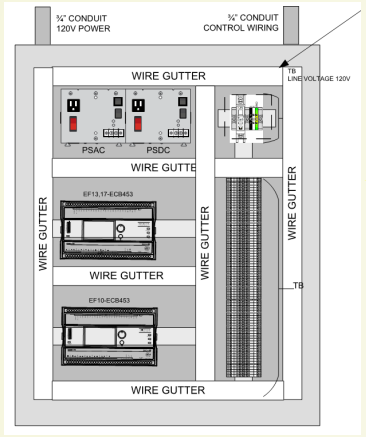
Digital Output
Relay – Dry Contacts

HOW MICROCONTROLLERS TURN RELAYS ON/OFF



Note:
Don't get hung up on the electronics here.
Not all components shown.

"Layout-Awareness" – Component Locations



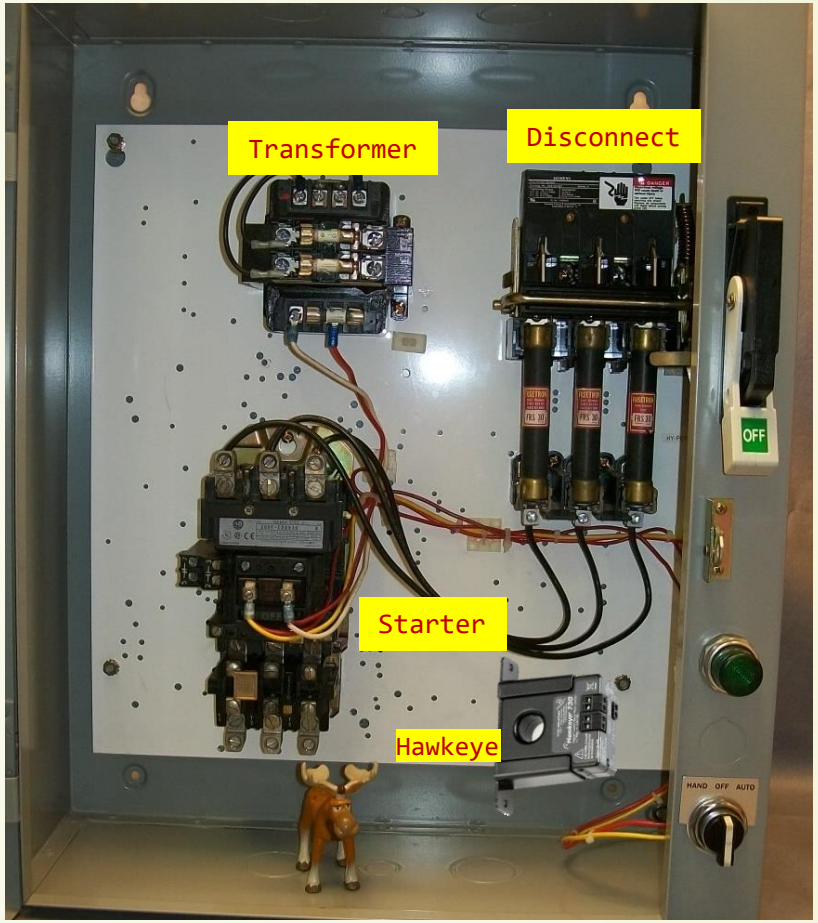
WAC Supplied Control Panel

Locate Close to Input/Sensors

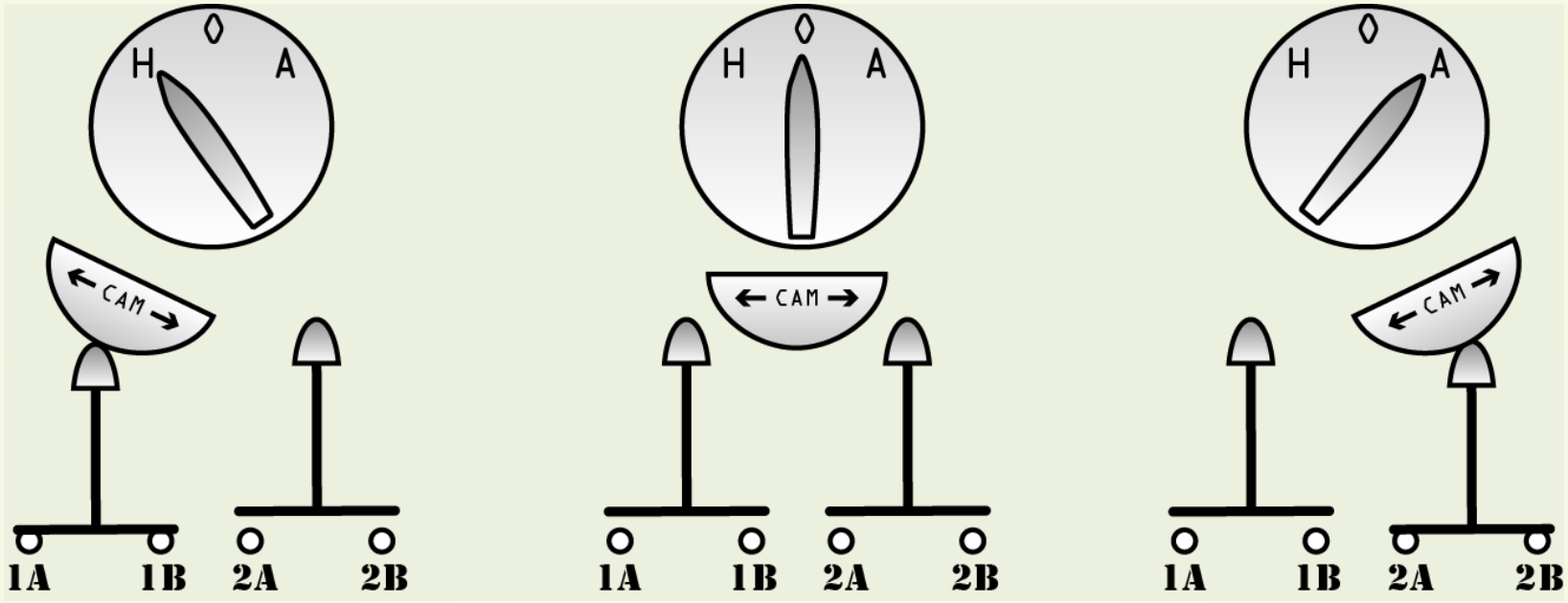
How Far?

MCC by Electrical

Sometimes, the starters are free-standing, not in a MCC



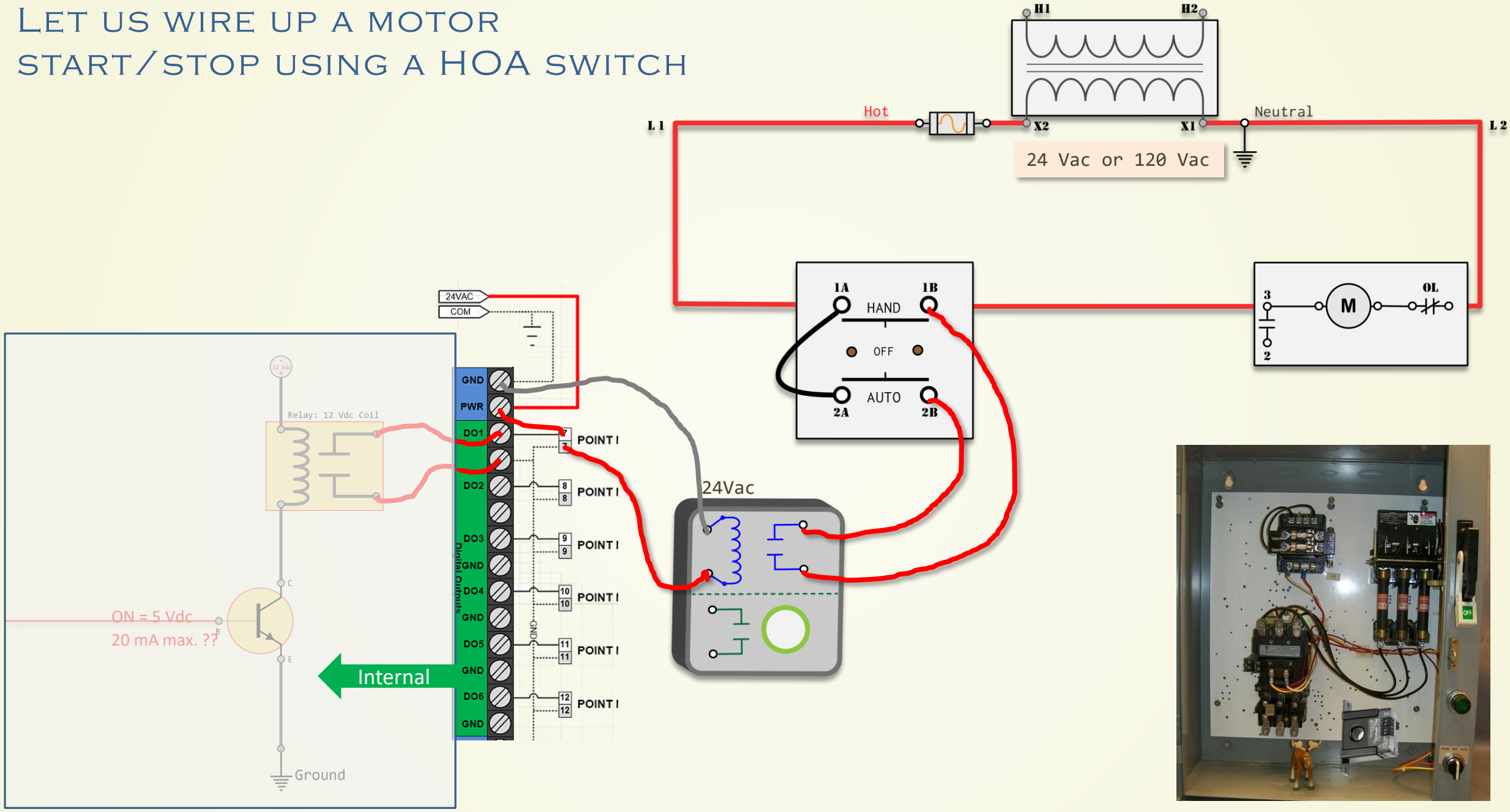
Motor Starter and Disconnect in MCC HOA Switch on Starter



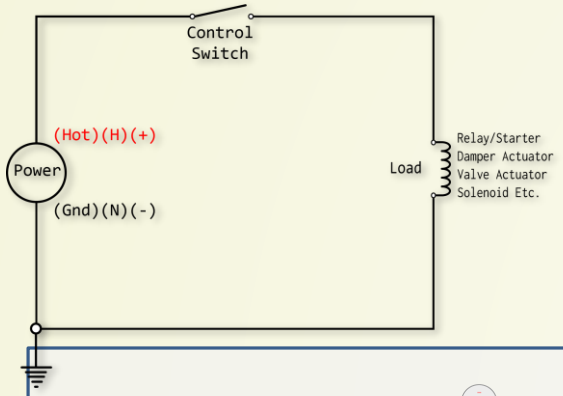
CONTACT	H	O	A
1A – 1B	CLOSED	OPEN	OPEN
2A – 2B	OPEN	OPEN	CLOSED

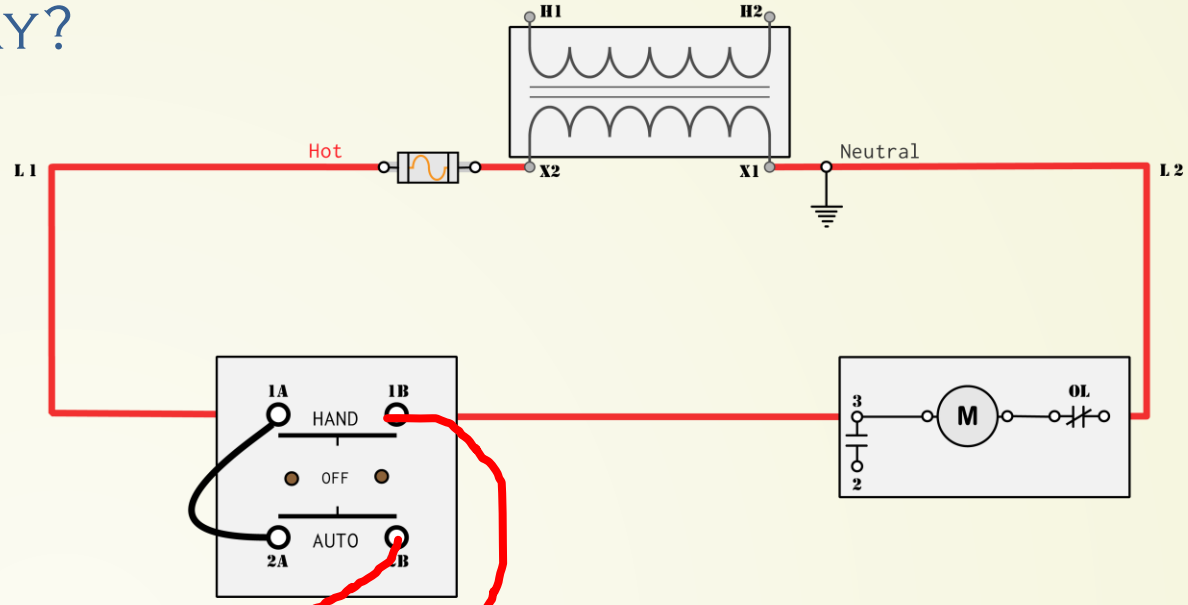
- The HOA switch belongs to a general family of switches known as “Cam Operated Selector Switches”.
- HOA switches have only 2 contacts.
- Basically, a Selector Knob turns a Cam that pushes pins at different locations to make or break contacts.
- These contacts cannot be considered either NO or NC.

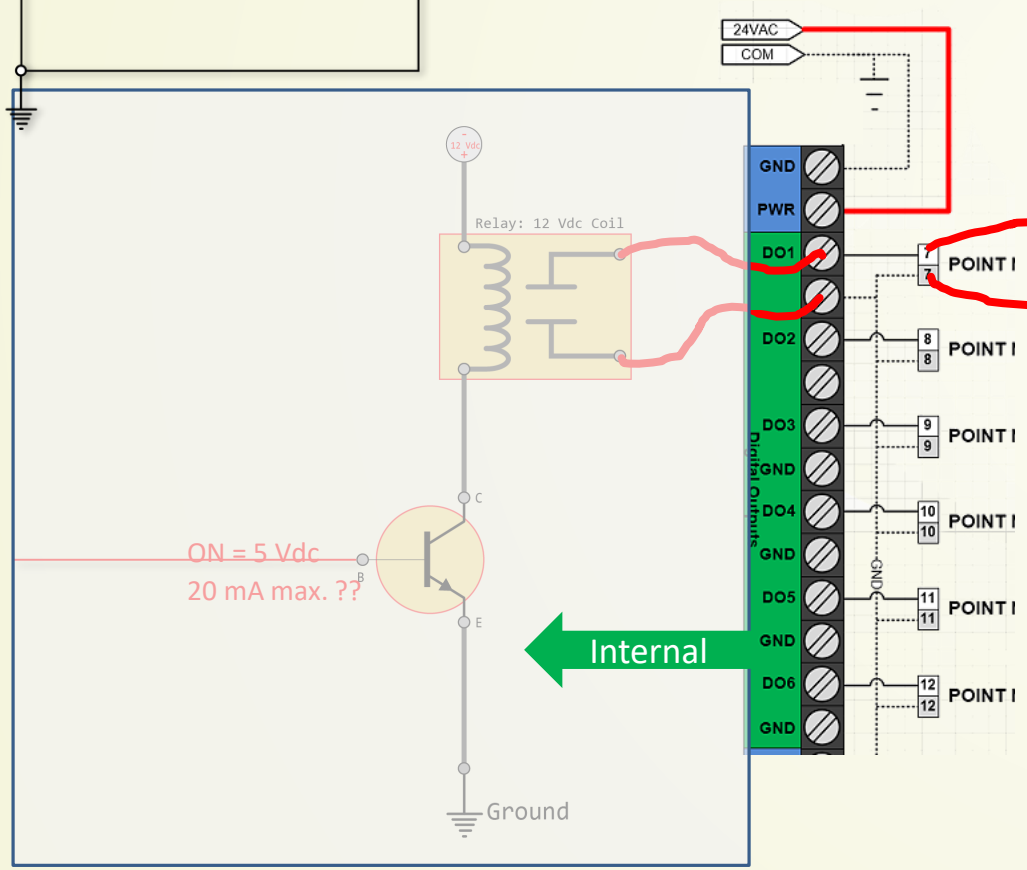
Let us wire up a motor start/stop using a HOA switch



Delete The Pilot (Middle) Relay?



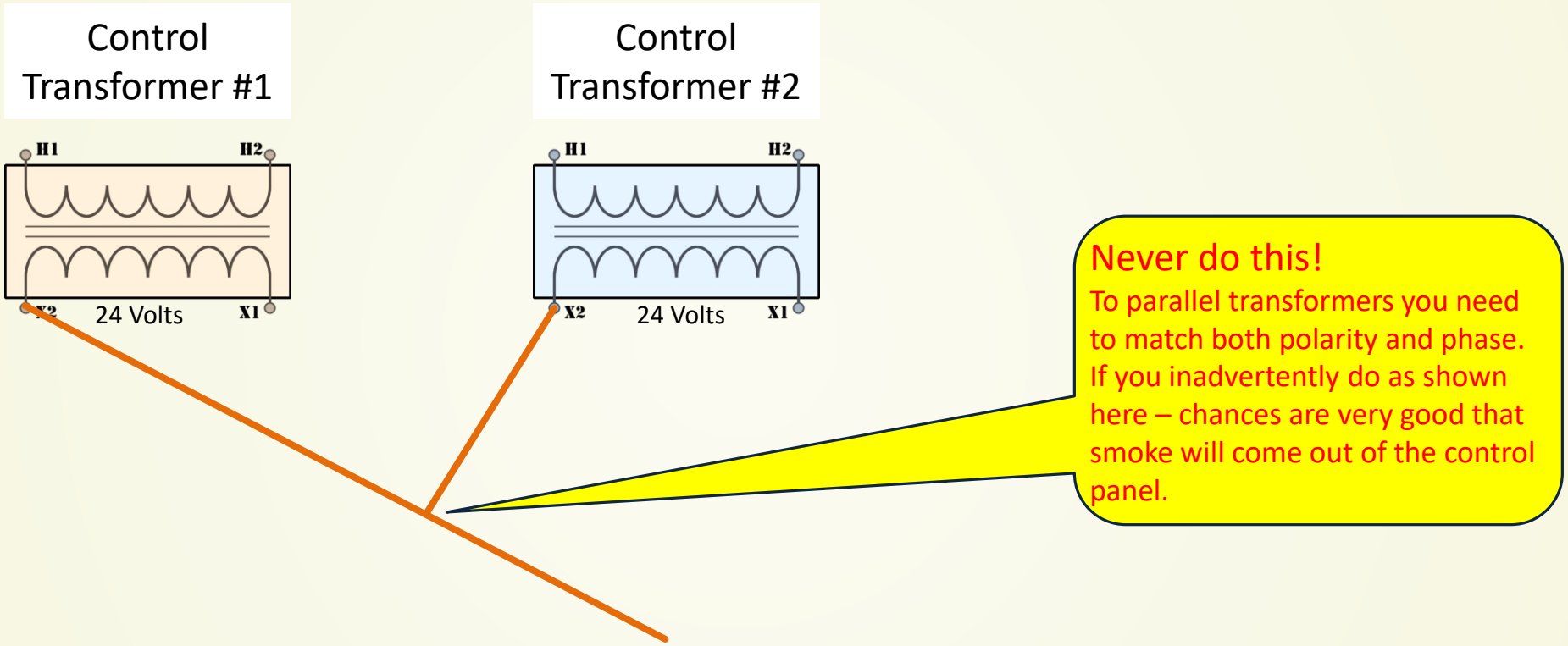




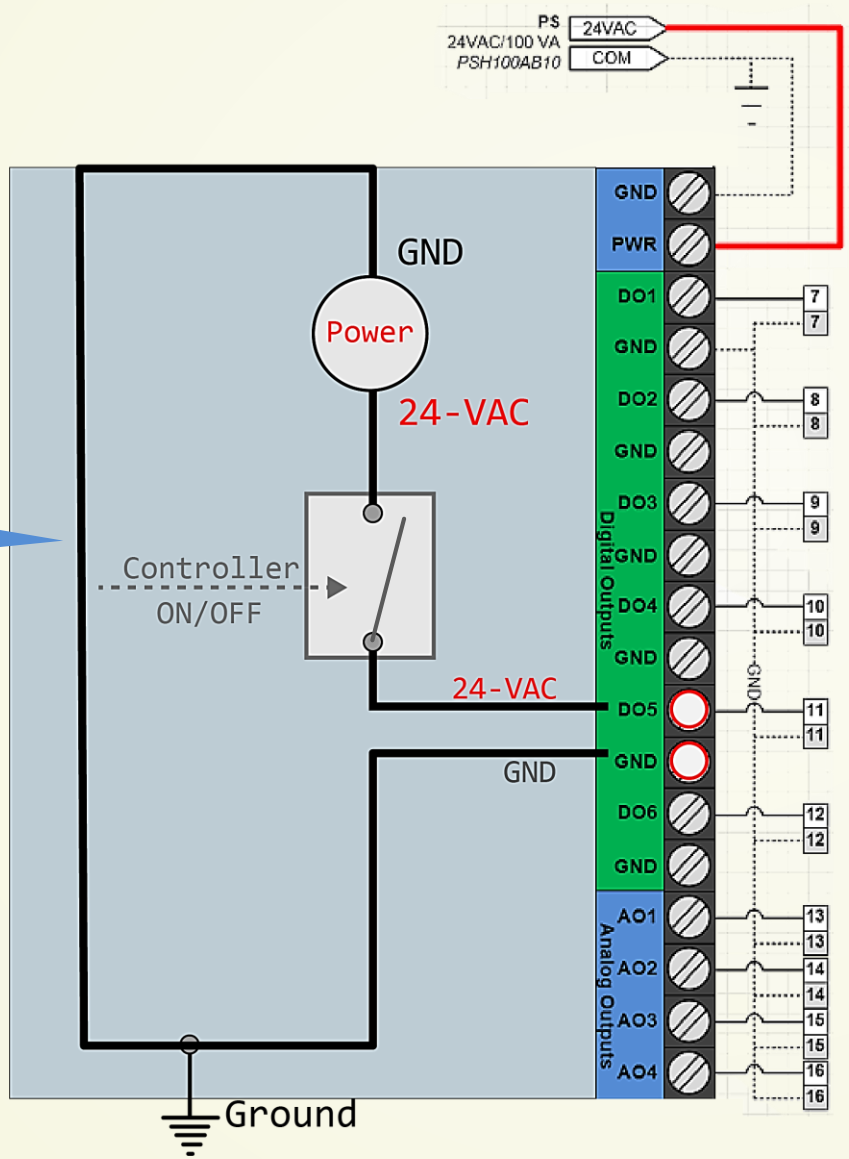
Starter Coil Load

Description		Contactor Catalog Number/Size		
		CN15A NEMA Size 00	CN15B NEMA Size 0	CN15D NEMA Size 1
Maximum Horsepower (hp)				
1-Phase	115V	1/3	1	2
	230V	1	2	3
3-Phase	200V	1-1/2	3	7-1/2
	230V	1-1/2	3	7-1/2
	460V	2	5	10
	575V	2	5	10
AC Magnet Coil Data				
Pick-Up Volts — Cold		74%	74%	74%
Pick-Up Volts — Hot		78%	78%	78%
Pick-Up Voltamperes		80	100	230
Pick-Up Watts		49	65	95
Sealed Voltamperes		7.5	10	28
Sealed Watts		2.4	3.1	7.8

Never Mix Transformer Power



Smart Controls Triac Outputs

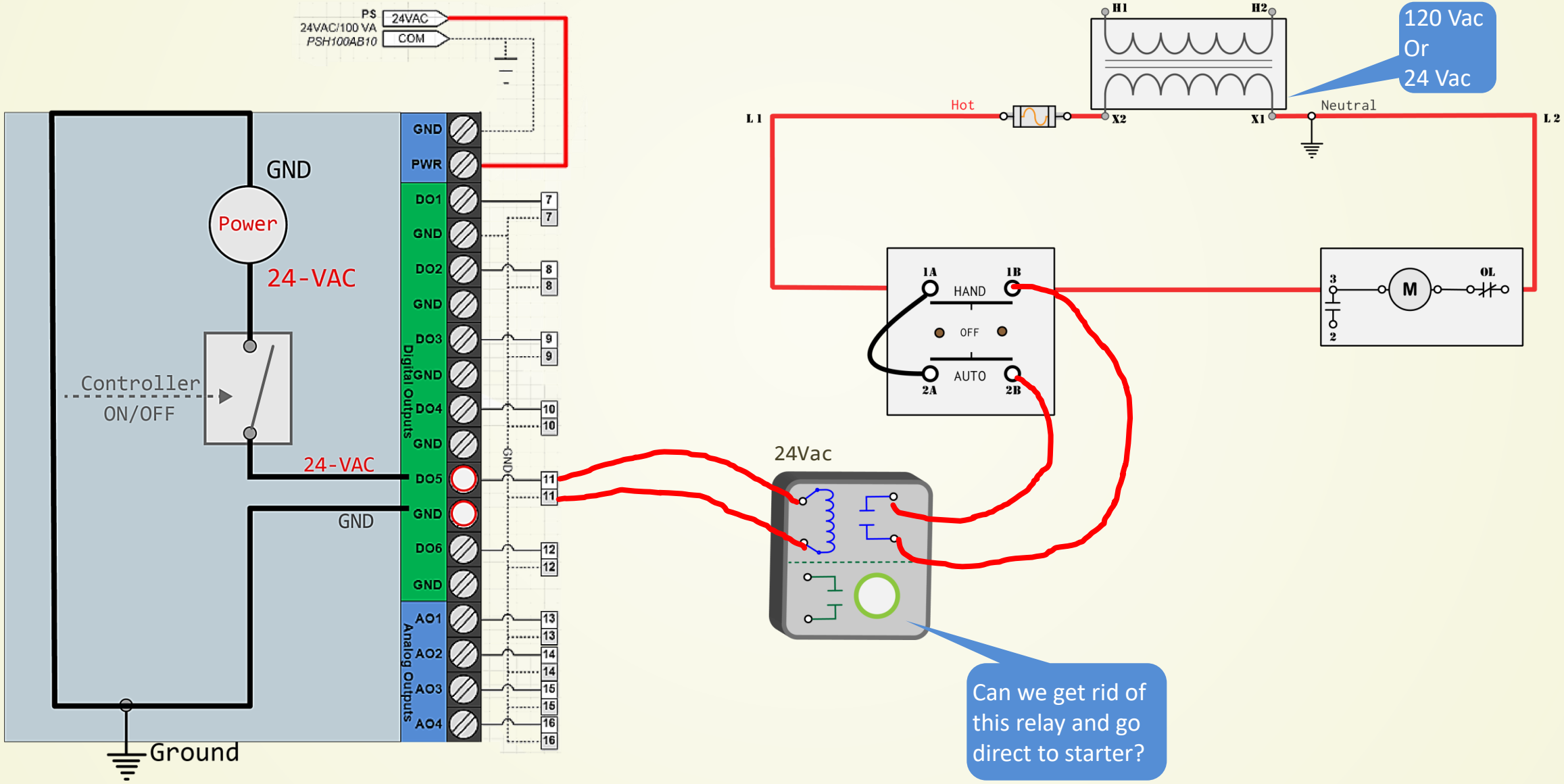


Inside the Smart Controls Unit

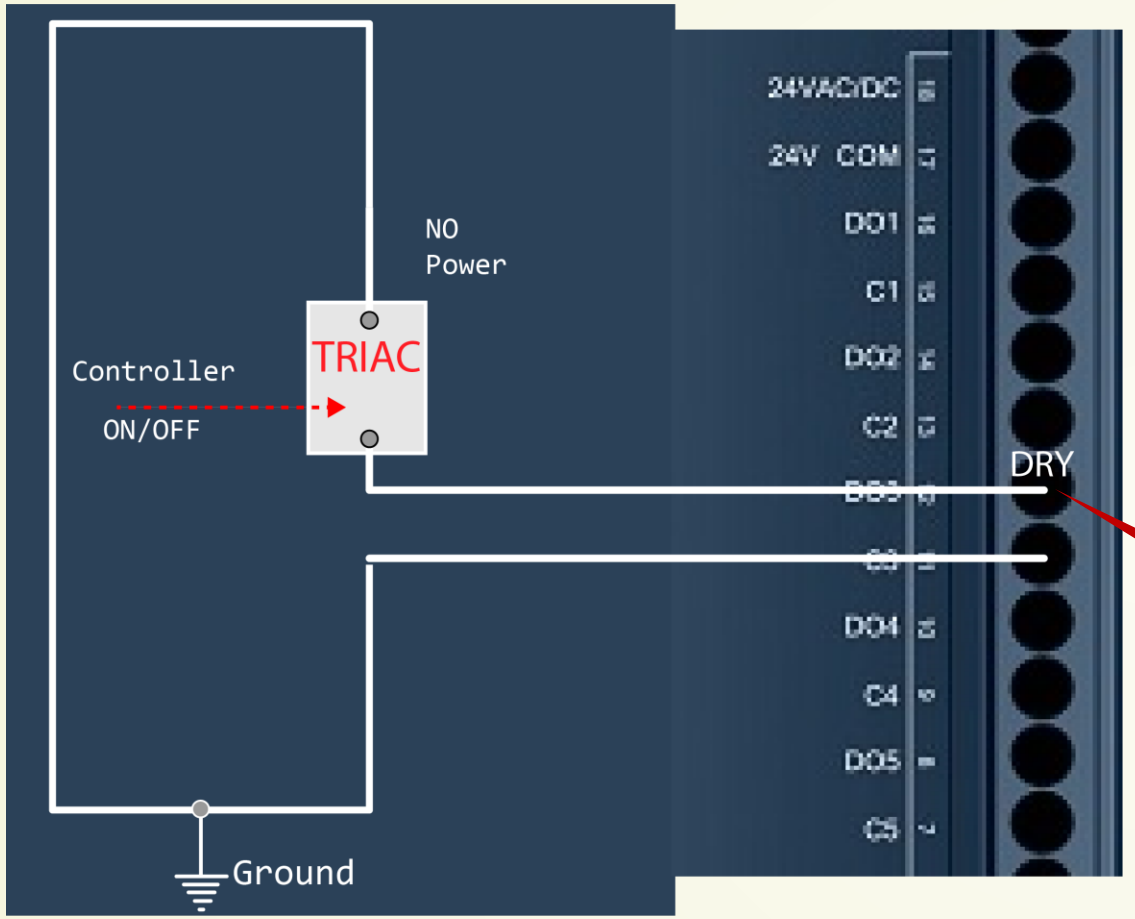
Outputs	
Number:	10
6- Digital:	Triac 1.0 A @ 24 VAC Voltage Sourcing
4-Analog:	0-10V
Analog Resolution:	12 bit
Accuracy:	±1%FS (25°C, 77°F)
Protection Circuitry:	ESD

Notes:
TVS not shown
How to troubleshoot?

Wiring Smart Controls Triac Outputs



Distech Triac Output



Need an external 24Vac Power Supply to pull in a relay coil

Wiring Triac Outputs

Digital outputs are all made of triacs and there is no voltage present on the output terminals. Therefore, an external power source has to be added if necessary.

To measure the state of a triac output, an external load must be connected.

Troubleshooting

Connect the digital output according to the following figure if a relay is being controlled.

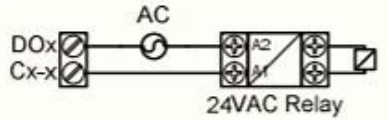
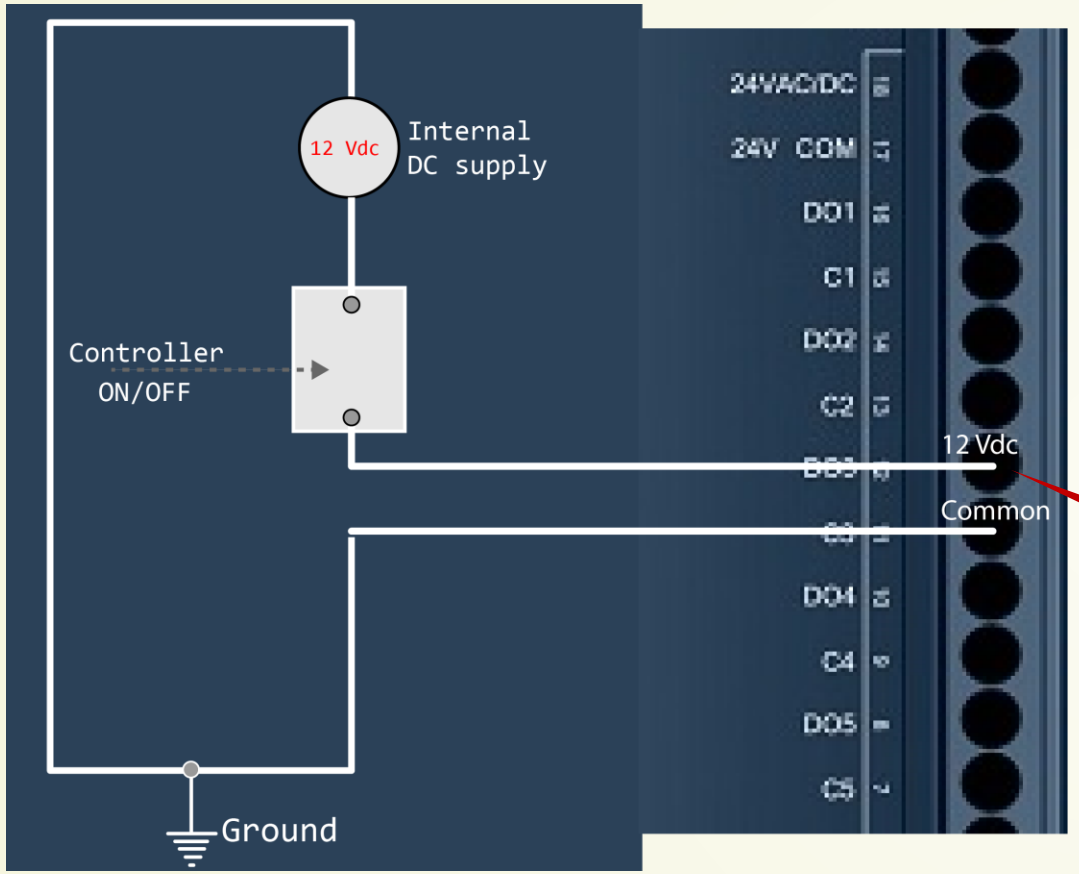


Figure 9-1: Digital triac output – Relay

Distech Discrete Output



Wiring Universal Outputs

Universal outputs can be configured to provide either a discrete signal of 0 or 12VDC, a linear signal ranging from 0 to 10VDC or a 0 to 20mA signal (ECP-400 Series and ECP-500 Series). The discrete signal can be used to generate a pulse wave modulation (PWM) signal or a simple two-state signal. These outputs are protected by an auto-reset fuse.

Wiring Discrete Outputs

When controlling a relay with a universal output, a diode must be connected in parallel to protect the controller from back-emf current which occurs when the relay is turned off. It is recommended to use diodes that are part of the 1N400x family and they should be placed closer to the relay.

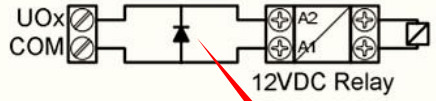
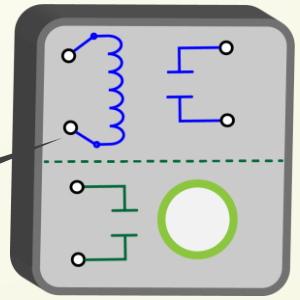


Figure 9-3: Discrete 0 or 12VDC universal output – Relay

TVS

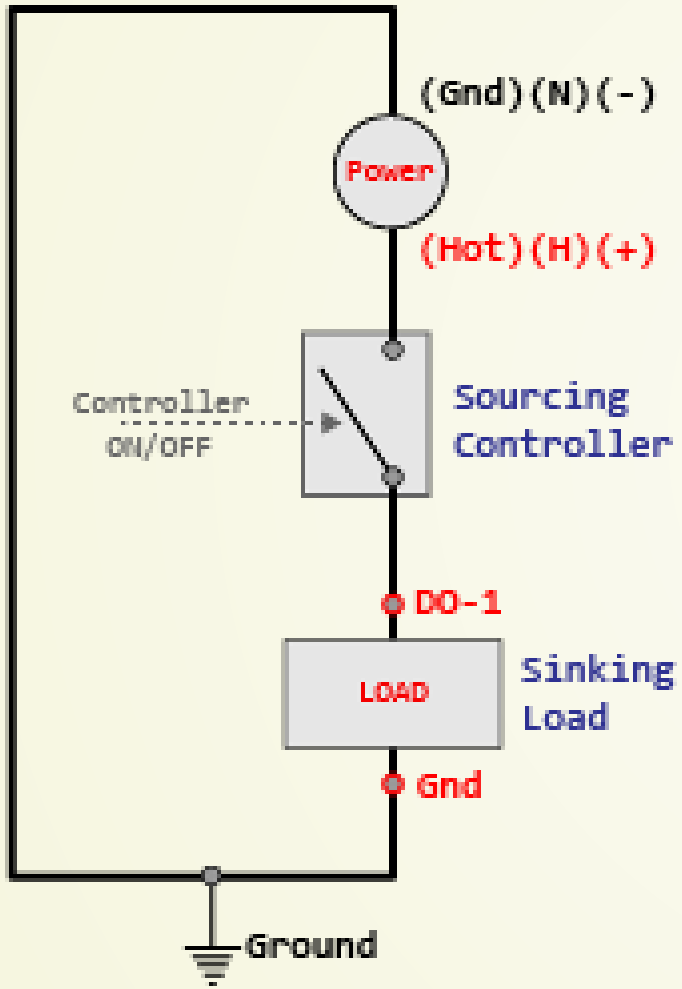
Need a 12 Volt DC Coil Relay (Powered by Controller)

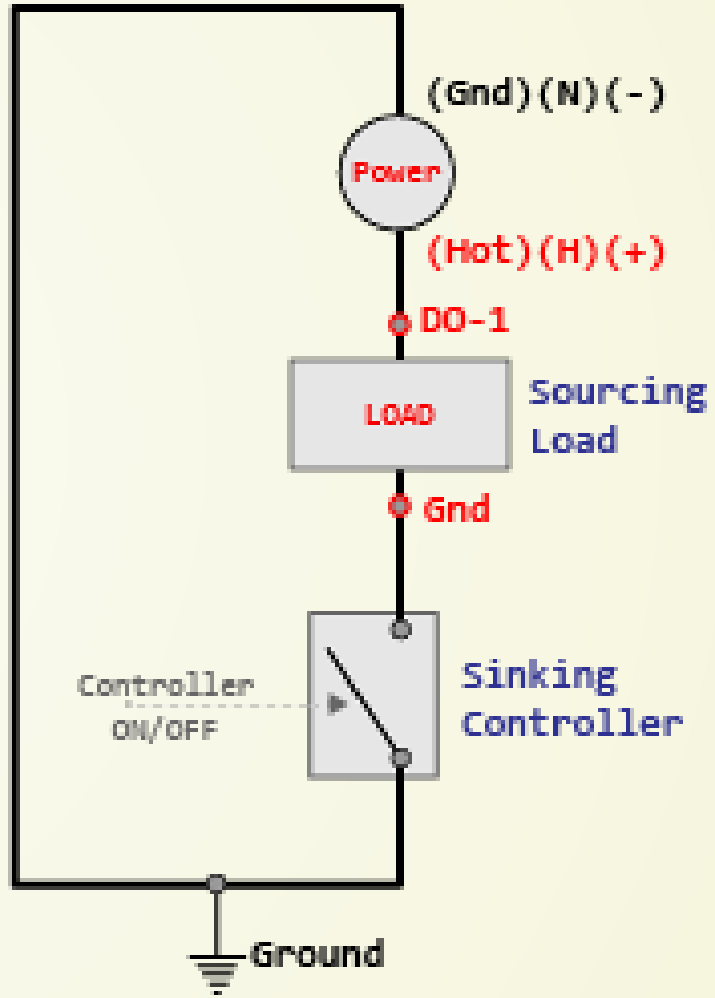


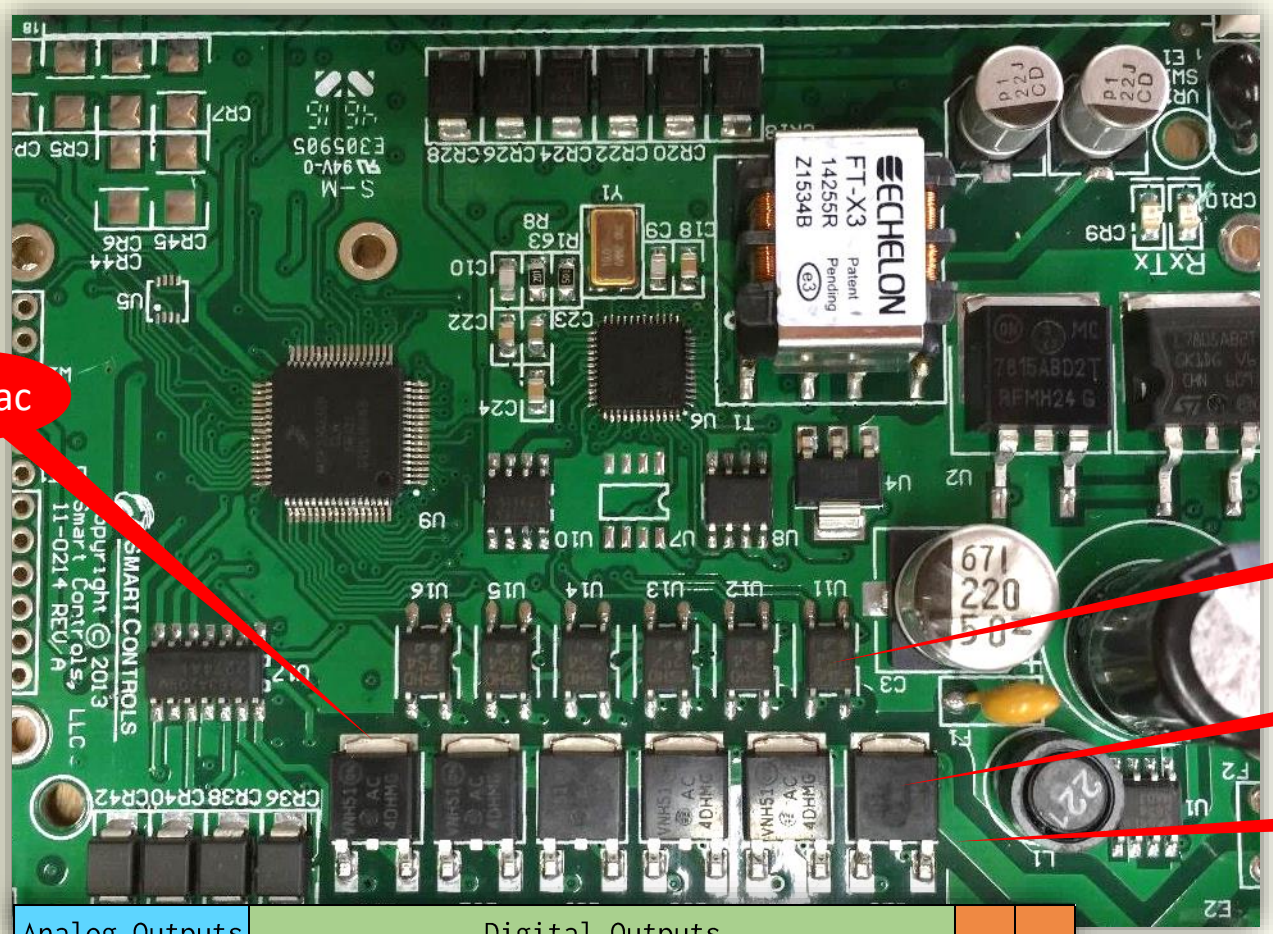
12 Volt DC Coil

Troubleshooting

Sourcing Vs Sinking Outputs





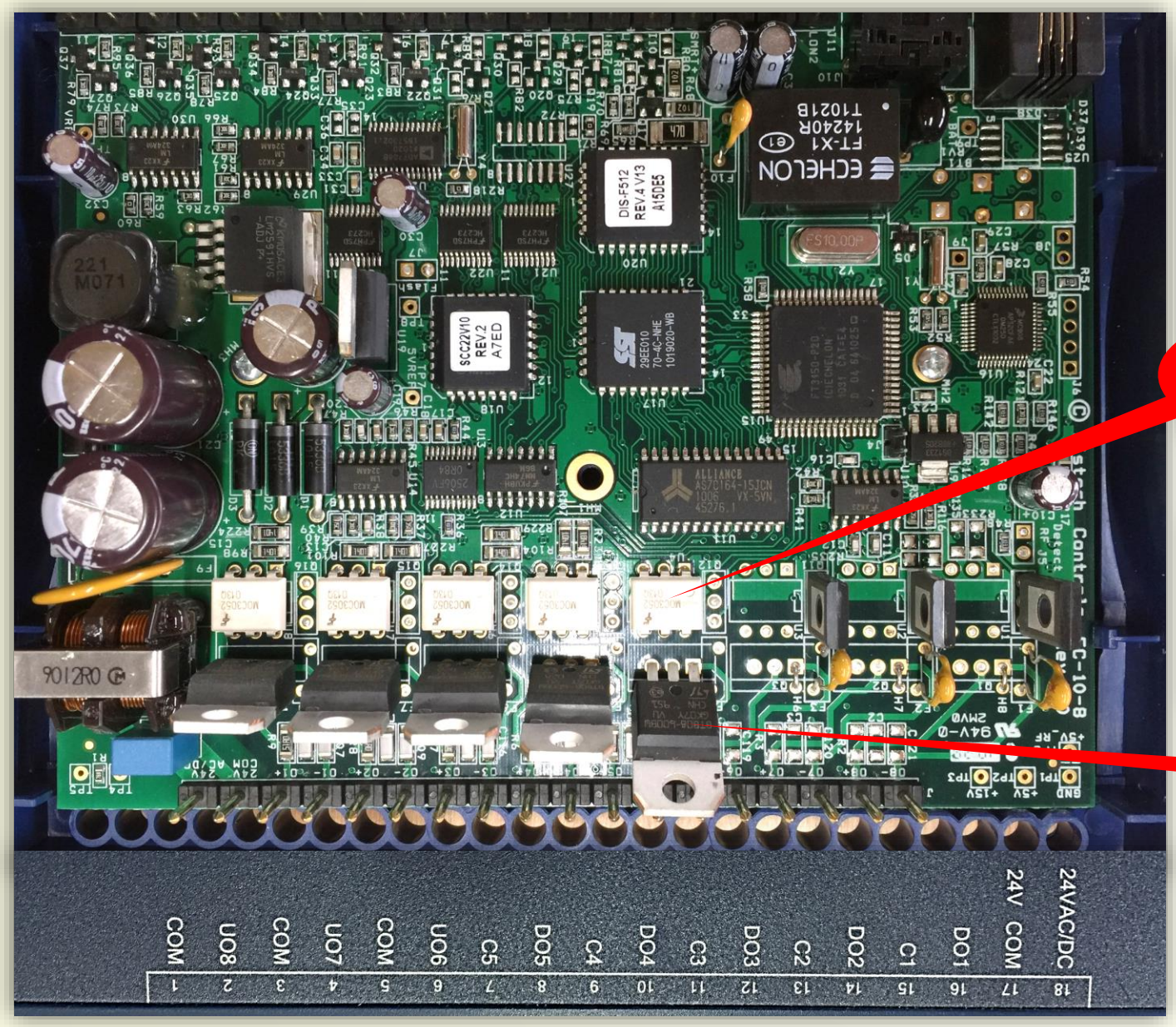


Analog Outputs				Digital Outputs													
AO-1	AO-2	AO-3	AO-4	GND	DO-6	GND	DO-5	GND	DO-4	GND	DO-3	GND	DO-2	GND	DO-1	PWR	GND
36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19

Outputs

Number:	*10*
6- Digital:	*Triac 1.0 A @ 24 VAC Voltage Sourcing*
4-Analog:	*0-10V*
Analog Resolution:	*12 bit*
Accuracy:	*±1%FS (25°C, 77°F)*
Protection Circuitry:	*ESD*

Smart Controls SC-160



Distech ECP-203

Outputs

Digital	24 VAC Triac, digital (on/off), PWM, or floating[1]; software configurable - 0.5A continuous - 1.0A @ 15% duty cycle for a 10-minute period - PWM control: adjustable period from 2 seconds to 15 minutes - Floating control: requires two consecutive outputs[1] - Min pulse on/off: 500msec. - Adjustable drive time period External or internal power supply (jumper selectable)

Opto Coupler

life.augmented

BTA08, BTB08, T810, T835, T850

Snubberless™, logic level and standard 8 A Triacs

Triac 0.5 Amp

Next Discussion:

- TVS - Transient Voltage Suppression
- Relay Contacts and Triac Ratings
- Control Transformer Sizing

(All Above Are Related Topics)