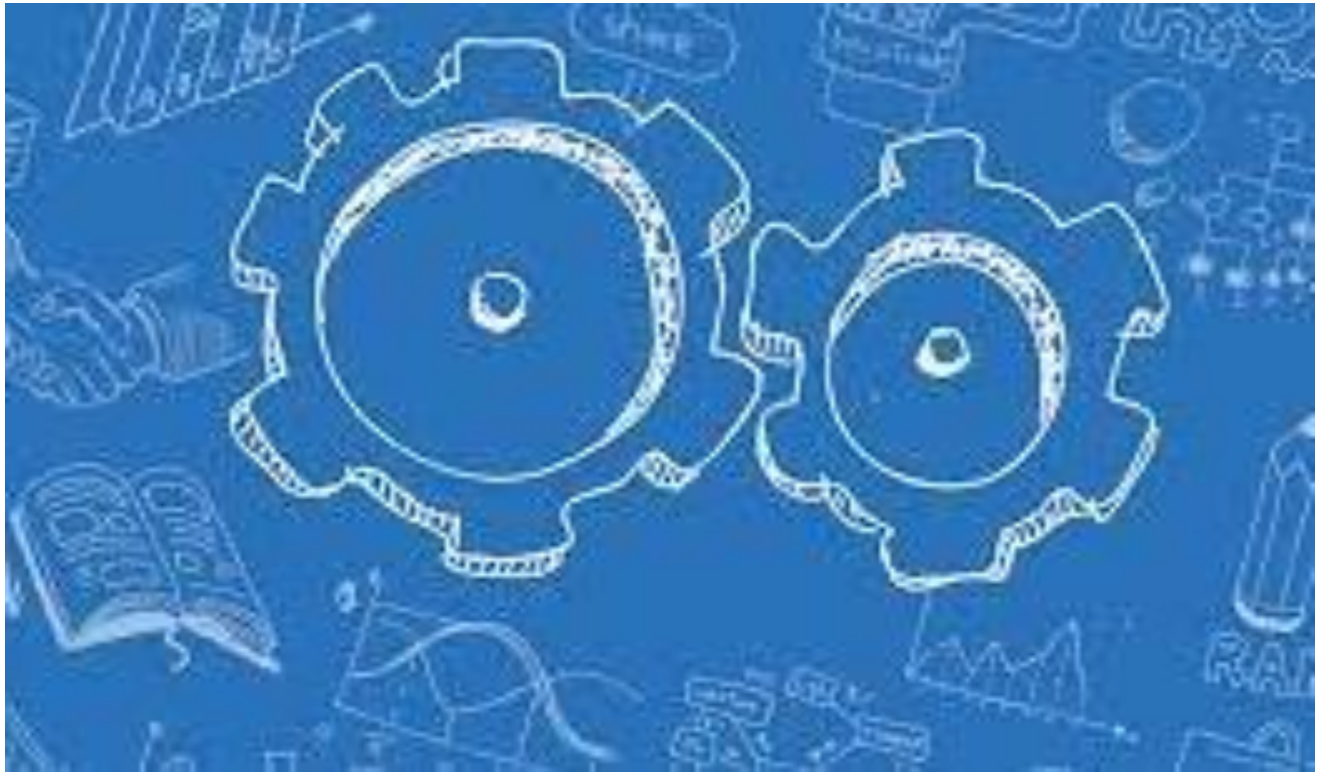
Dynalectric
San Diego
An EMCOR Company

Internship Presentation

By: Preston Gomersall

Learning the Engineering Language



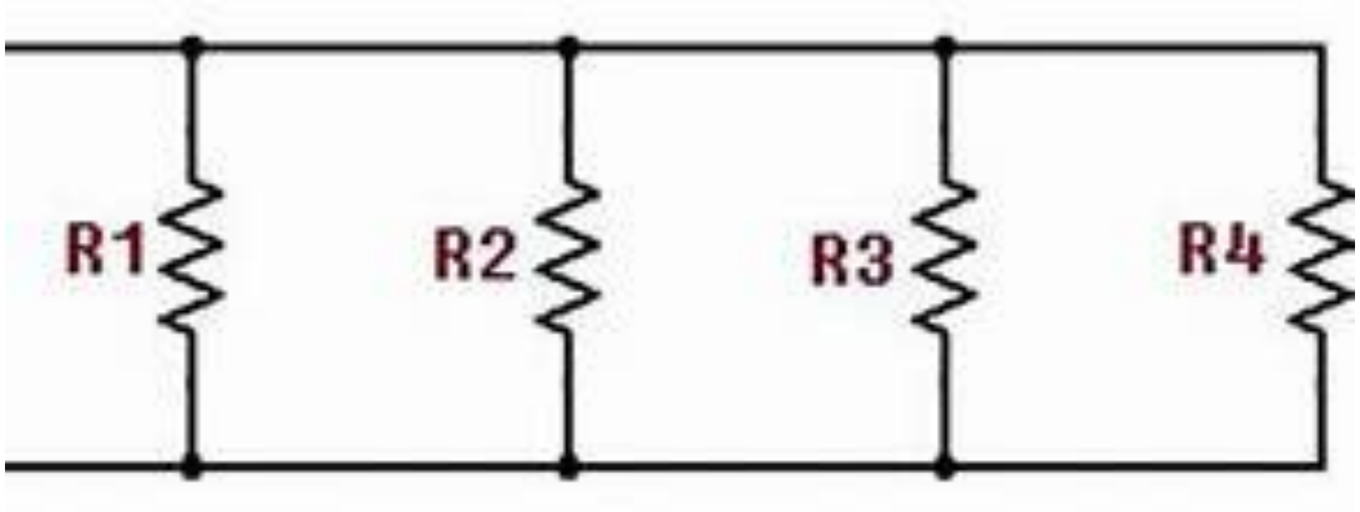
Acronyms and abbreviations.
Ex: SOP, SOV, RIO, CIP, P&ID, VFD, etc.

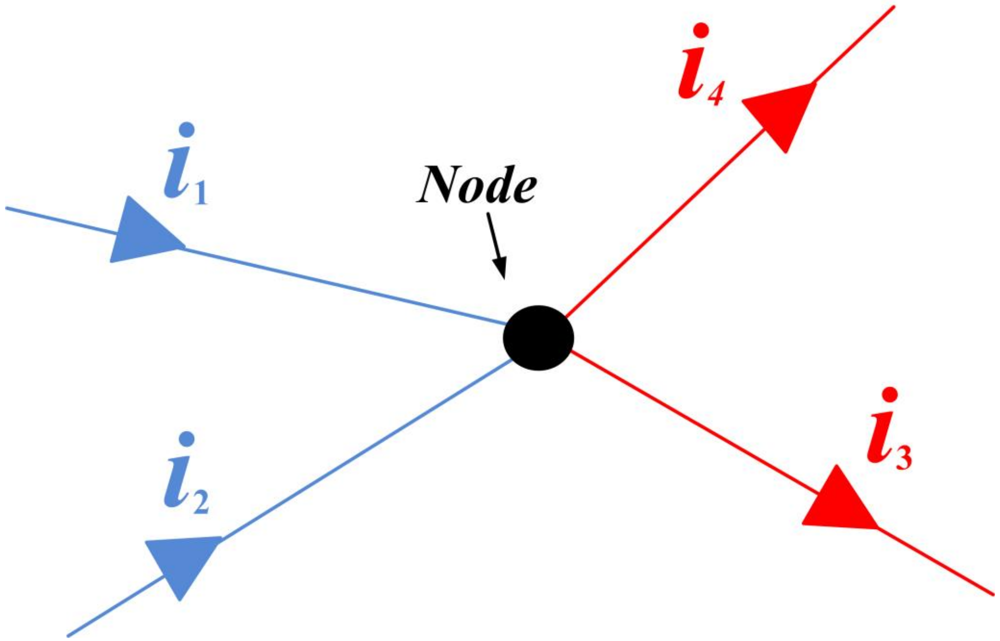
Learning Software

AUTOCAD

Understanding Control Panel and Instruments

Wiring diagram





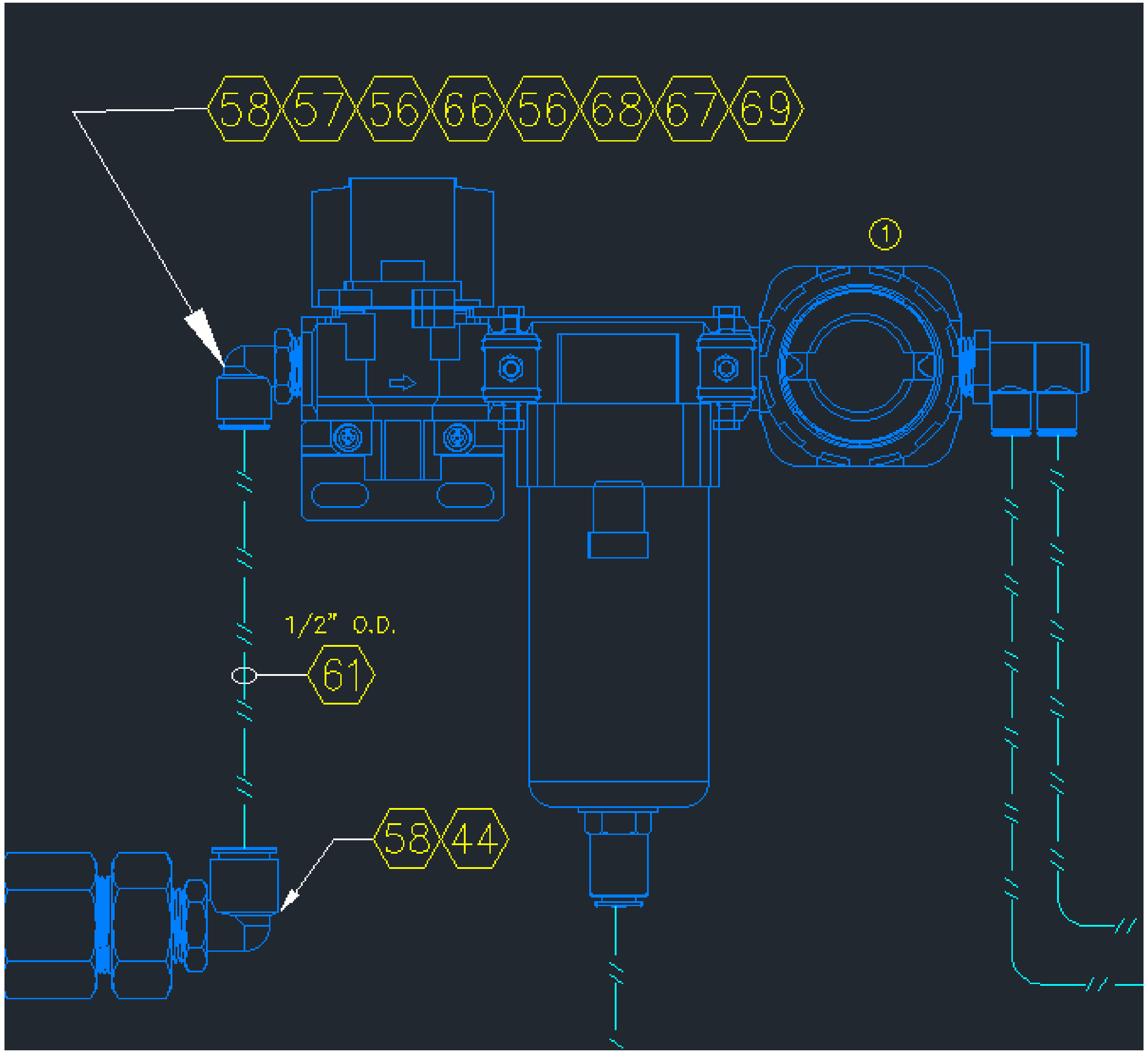
PLC’s

POWER
ETHERNET
RXD TXD OK
ControlNet
ERR
OK
Logix5550
RUN I/O
RS232
BAT OK
RUN REM PROG
DC INPUT
DC OUTPUT
ELECTRONIC FUSING
DC INPUT
DC OUTPUT
ELECTRONIC FUSING
Allen-Bradley

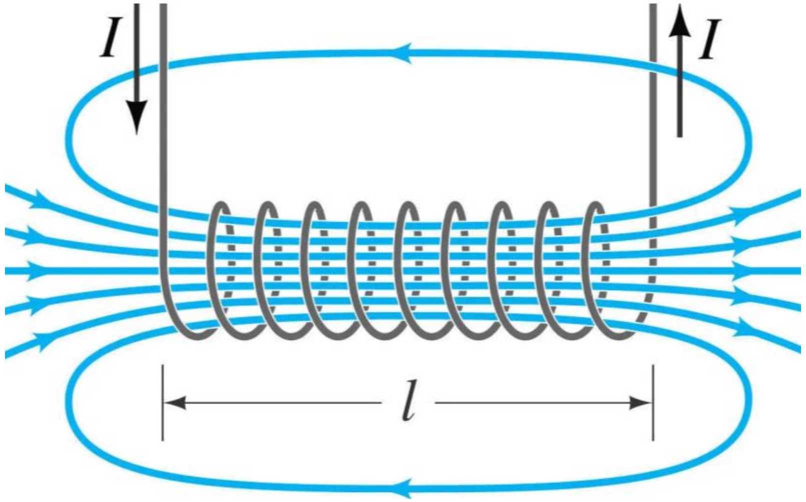
REO Temp Visit

$$R = \frac{PL}{A} \qquad P = Resistivity = P_0(1 + \alpha * \Delta T)$$

My Pressure Regulator



Solenoid Valve

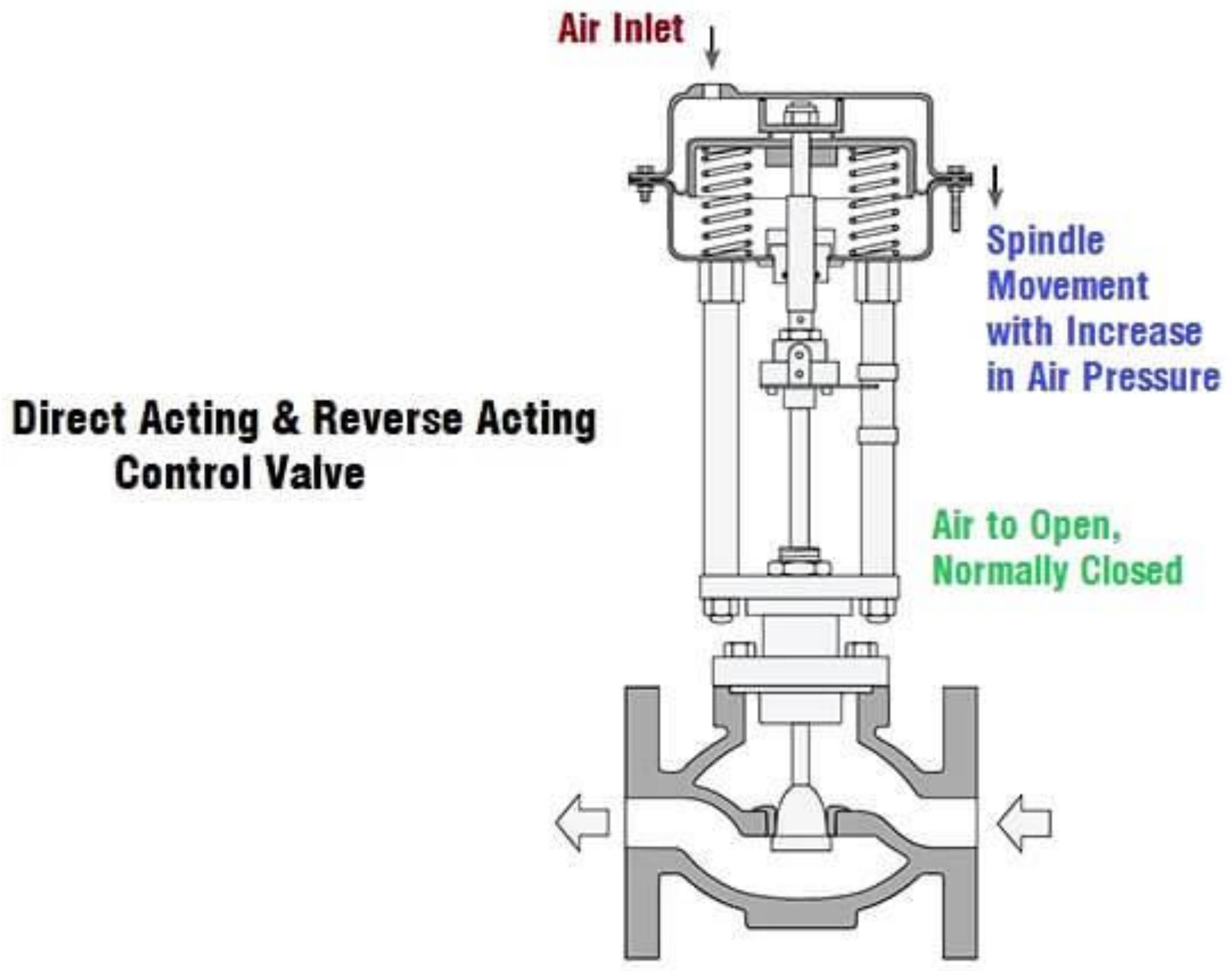


Biot-Savart Law

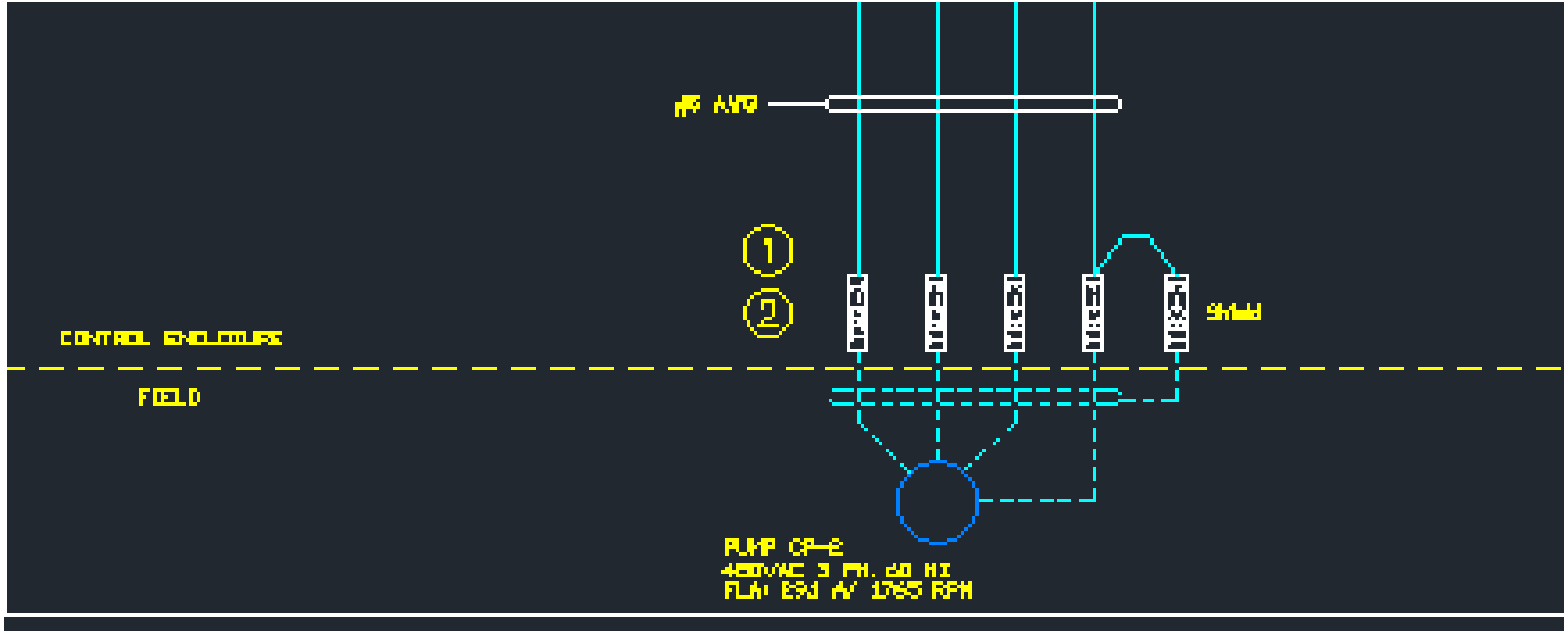
$$\boxed{\mathbf{dB} = \frac{\mu_o}{4\pi}\frac{I\mathbf{ds}\times\hat{\mathbf{r}}}{r^2}}$$

$$Ampere's\ Law\text{: } \oint \beta \cdot dS = \mu_0 \cdot I_{inside}$$

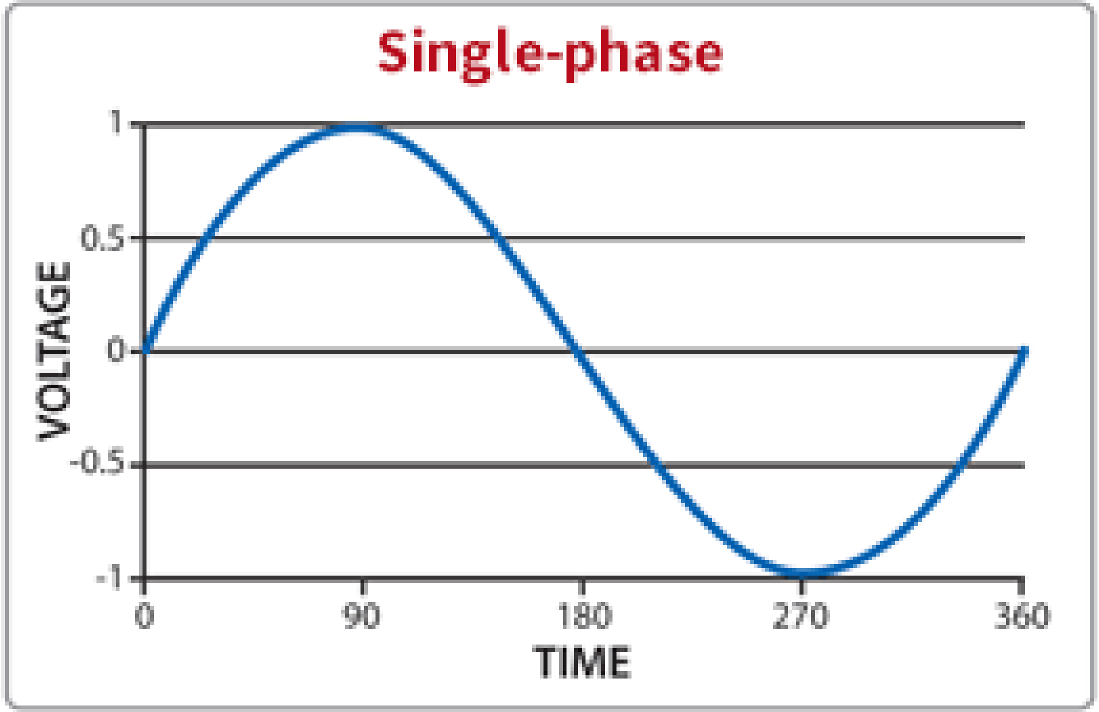
Pneumatic Valve Actuator

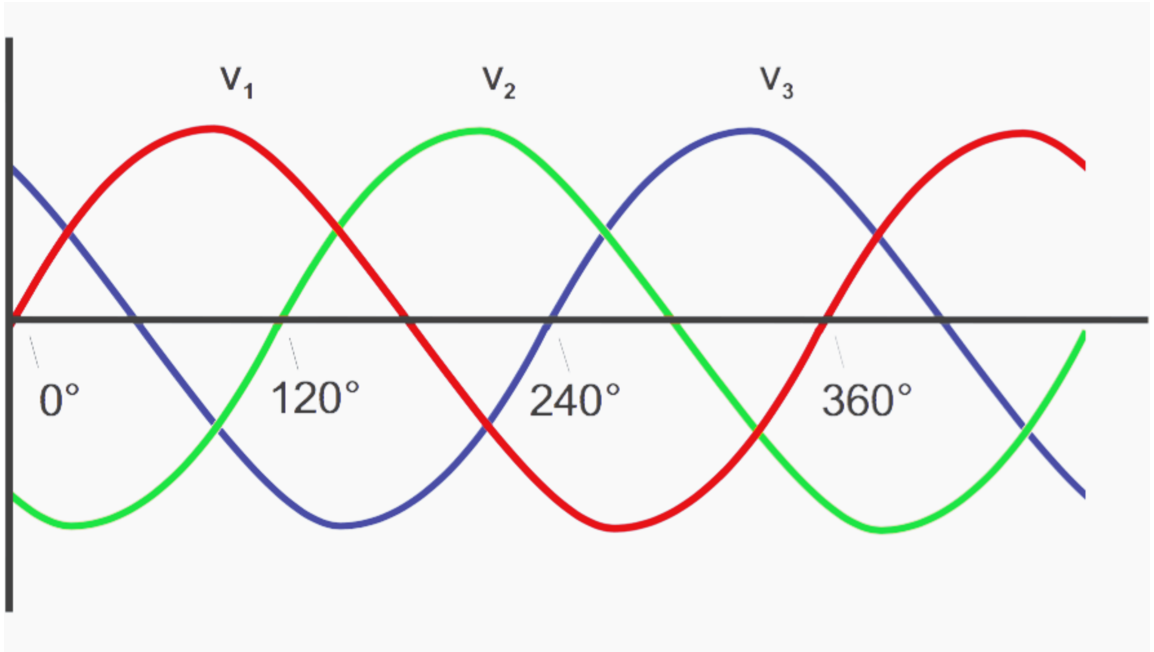


VFD Controlling Pump

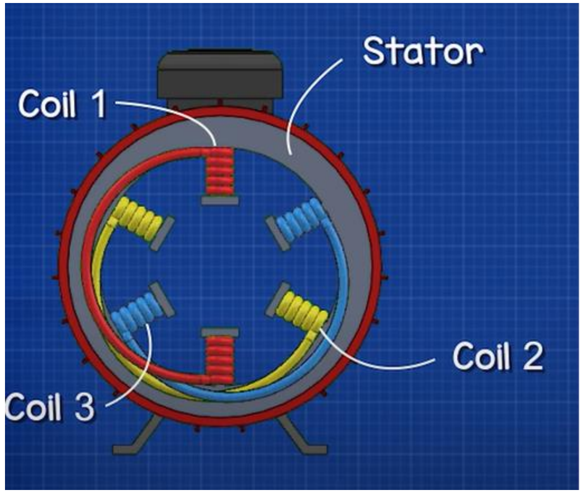


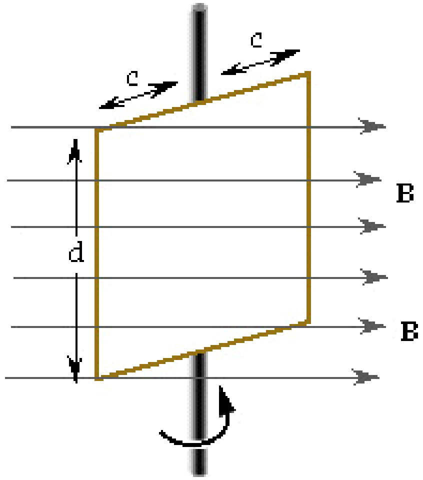
Three phase wiring





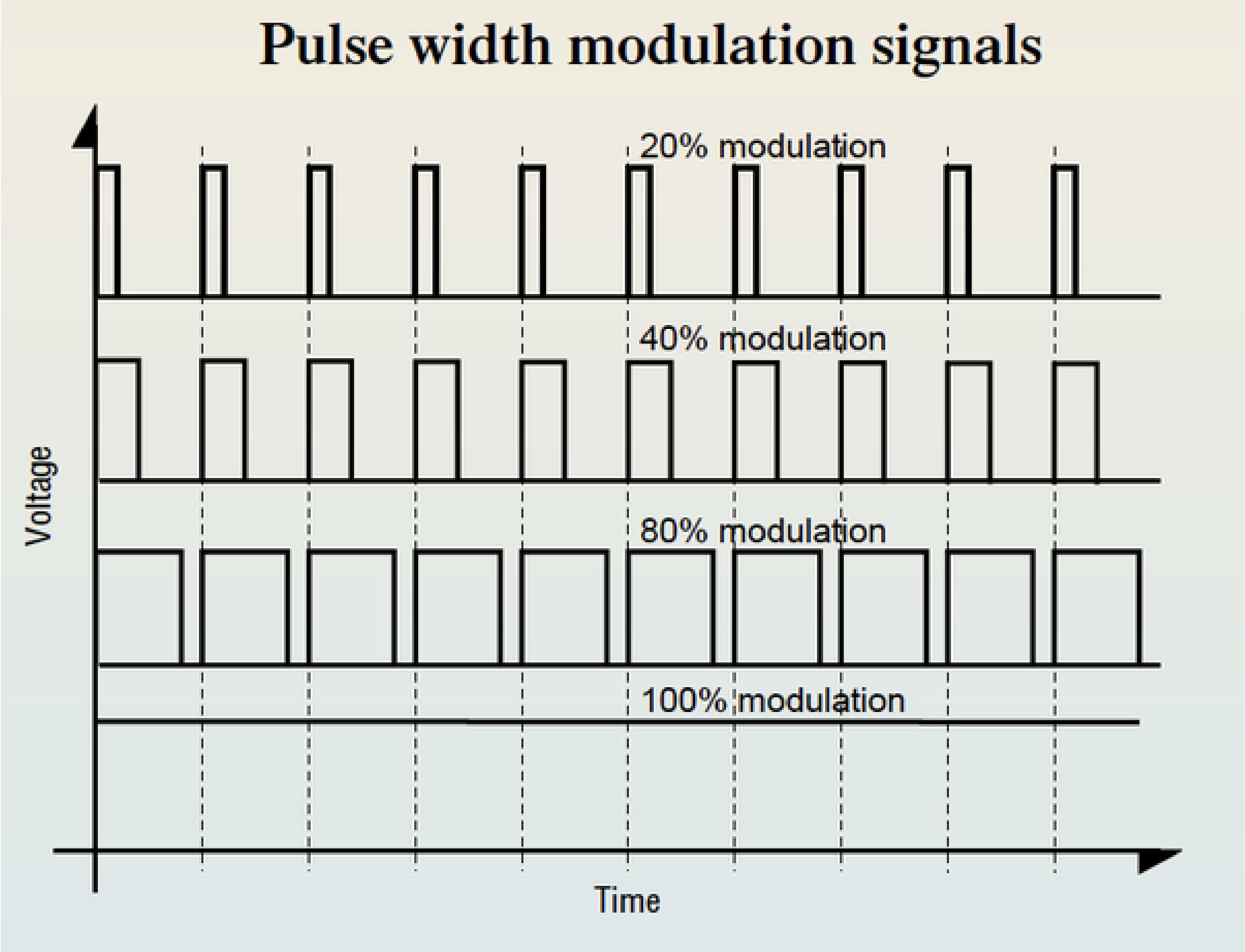
Basic Motor diagram



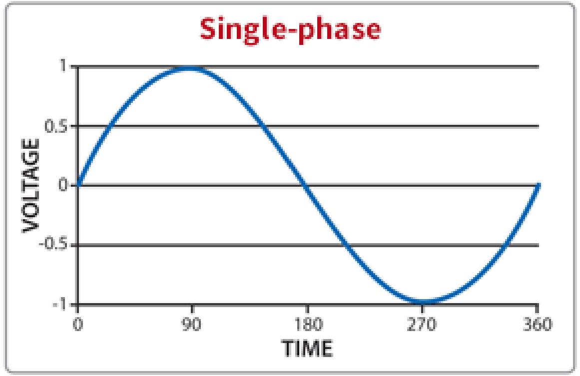


$$\mathcal{E} = -N\frac{\Delta\Phi}{\Delta t}$$

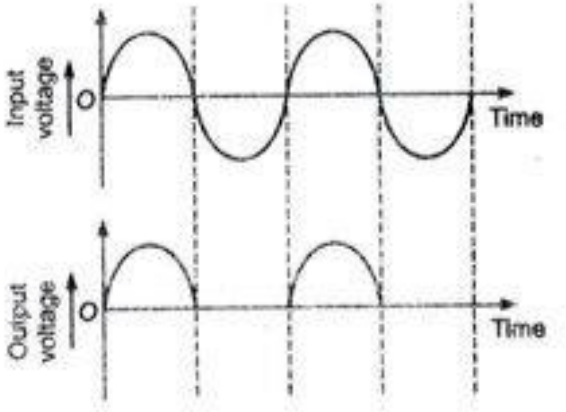
Pulse Width modulation



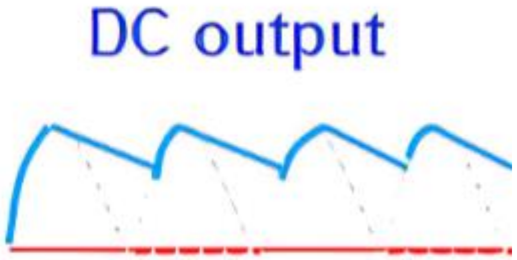
Rectifiers (AC to DC)



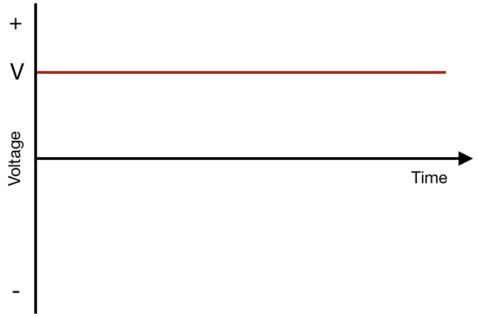
Diode



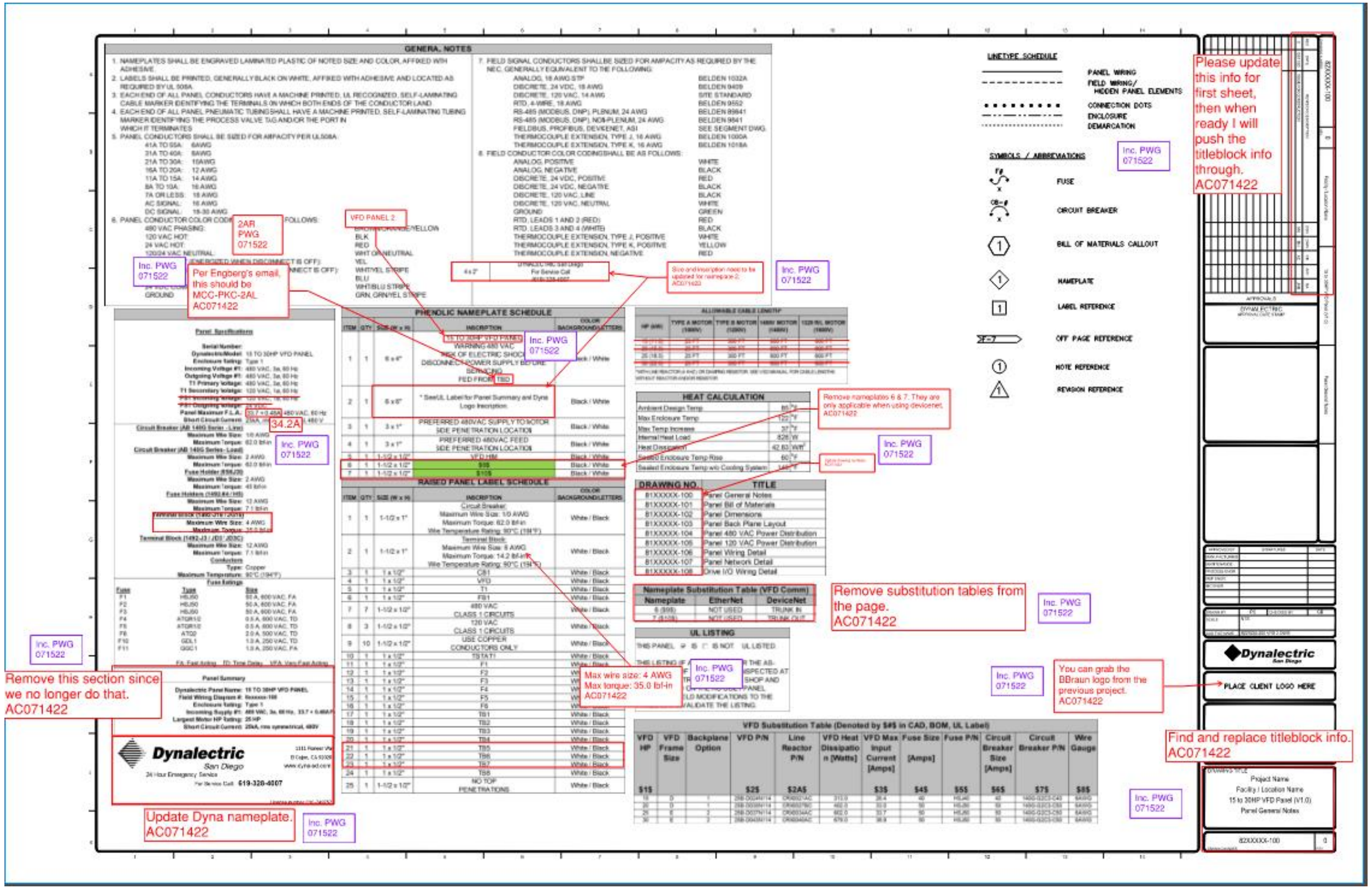
Capacitor



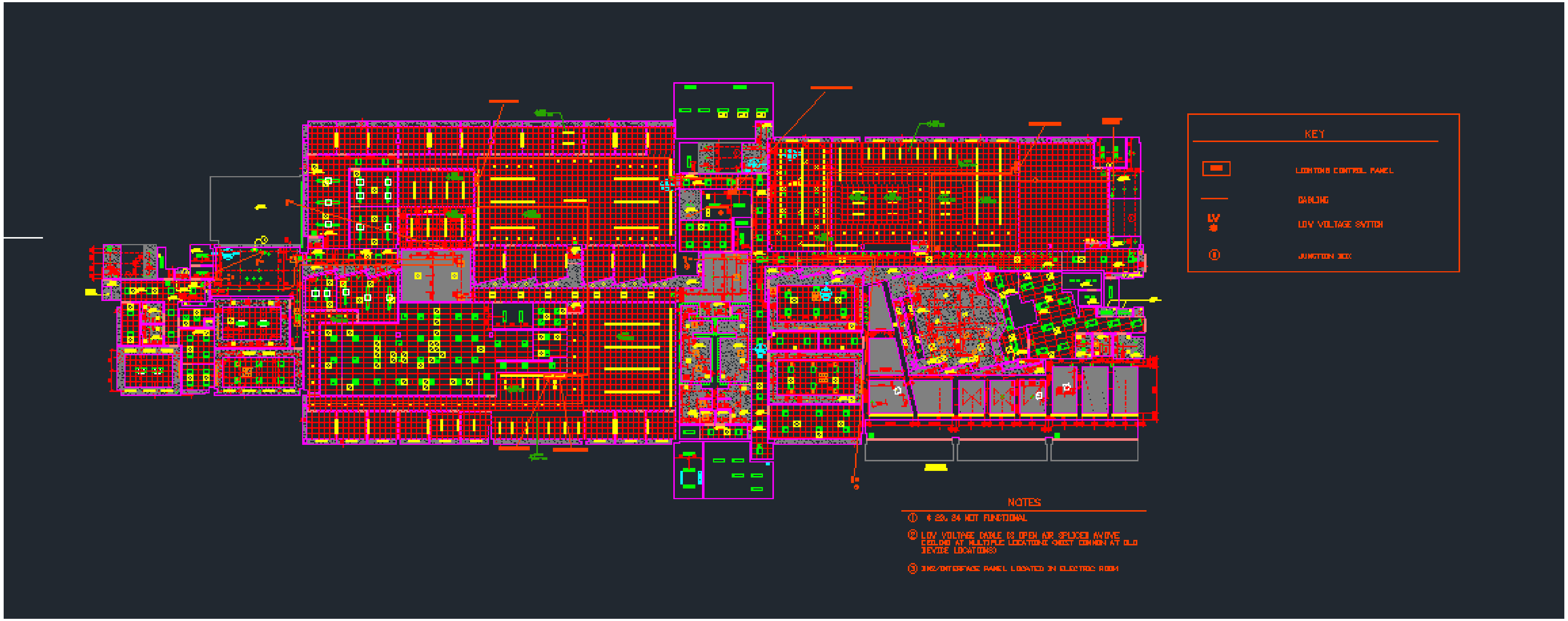
Voltage Regulator



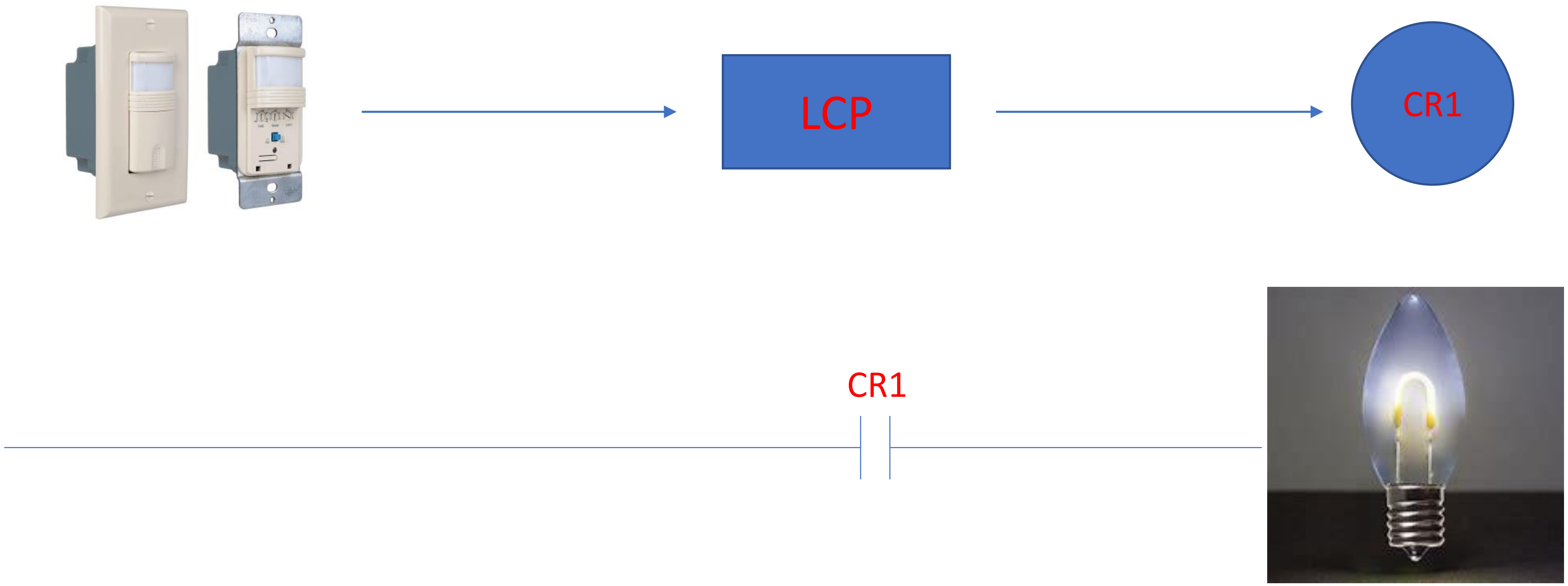
VFD for BBraun



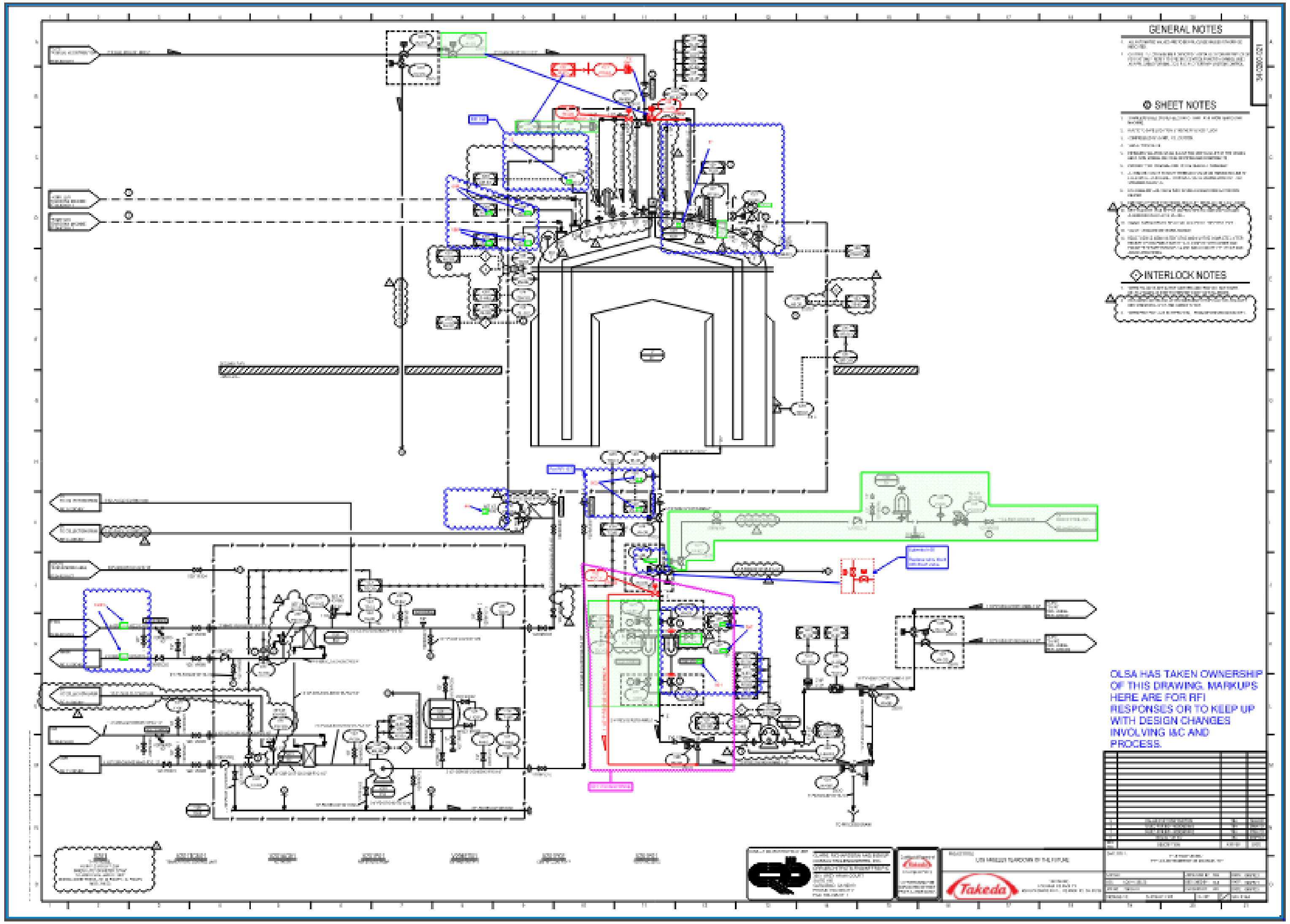
Genentech Lighting Plan



LCP’s function



P&ID's for Takeda



Crossover with MAE studies at UCSD

MAE 142 Dynamics and Controls

- This course covers the "Optimal state space control theory for the design of analog and digital controllers (autopilots)"

State Space

Example: Satellite attitude control (second-order system)

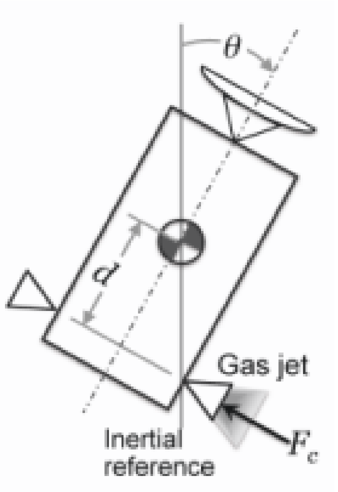
- Satellites require attitude control to ensure that antennas, solar panels, and sensors are correctly oriented. They have thrusters to achieve this.
- Jets produce a moment $F_c d$ about the center of mass ($x(t) = F_c(t)$ is the input force).
- Equation of motion is given by the **second order system**

$$I\ddot{\theta}(t) = F_c(t)d \tag{1}$$

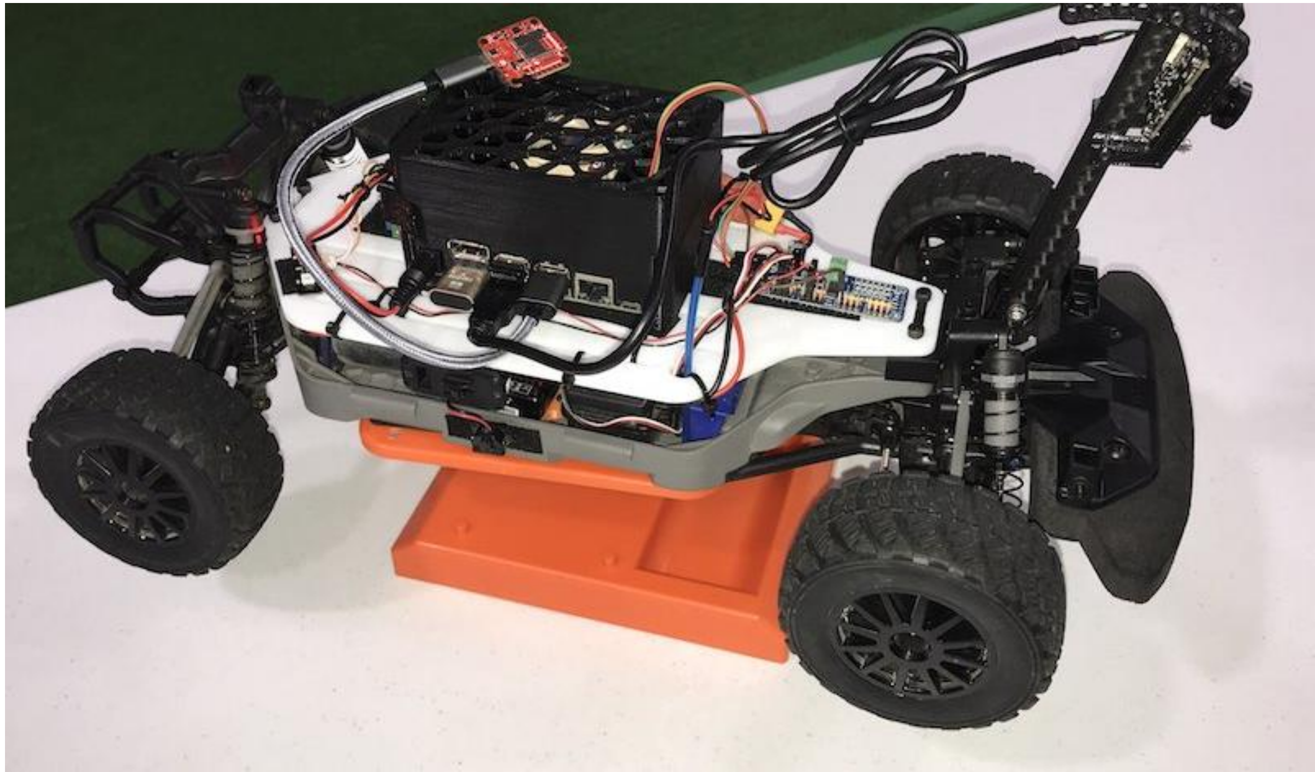
- Define the state $\mathbf{z}(t) = [z_1(t)\ z_2(t)] = [\theta(t)\ \dot{\theta}(t)]$, so $\dot{z}_1(t) = z_2(t)$. **We can write** (1) **as a first-order state-space model**

$$\begin{bmatrix}\dot{z}_1\\ \dot{z}_2\end{bmatrix} = \underbrace{\begin{bmatrix}0 & 1\\ 0 & 0\end{bmatrix}}_{\mathbf{A}}\begin{bmatrix}z_1\\ z_2\end{bmatrix} + \underbrace{\begin{bmatrix}0\\ \frac{d}{I}\end{bmatrix}}_{\mathbf{B}} F_c(t), \qquad y = \underbrace{\begin{bmatrix}1 & 0\end{bmatrix}}_{\mathbf{C}}\begin{bmatrix}z_1\\ z_2\end{bmatrix}$$

- **Converting second-order systems into first-order systems is a commonly used trick in systems modeling: The theory for first order systems is well developed.**

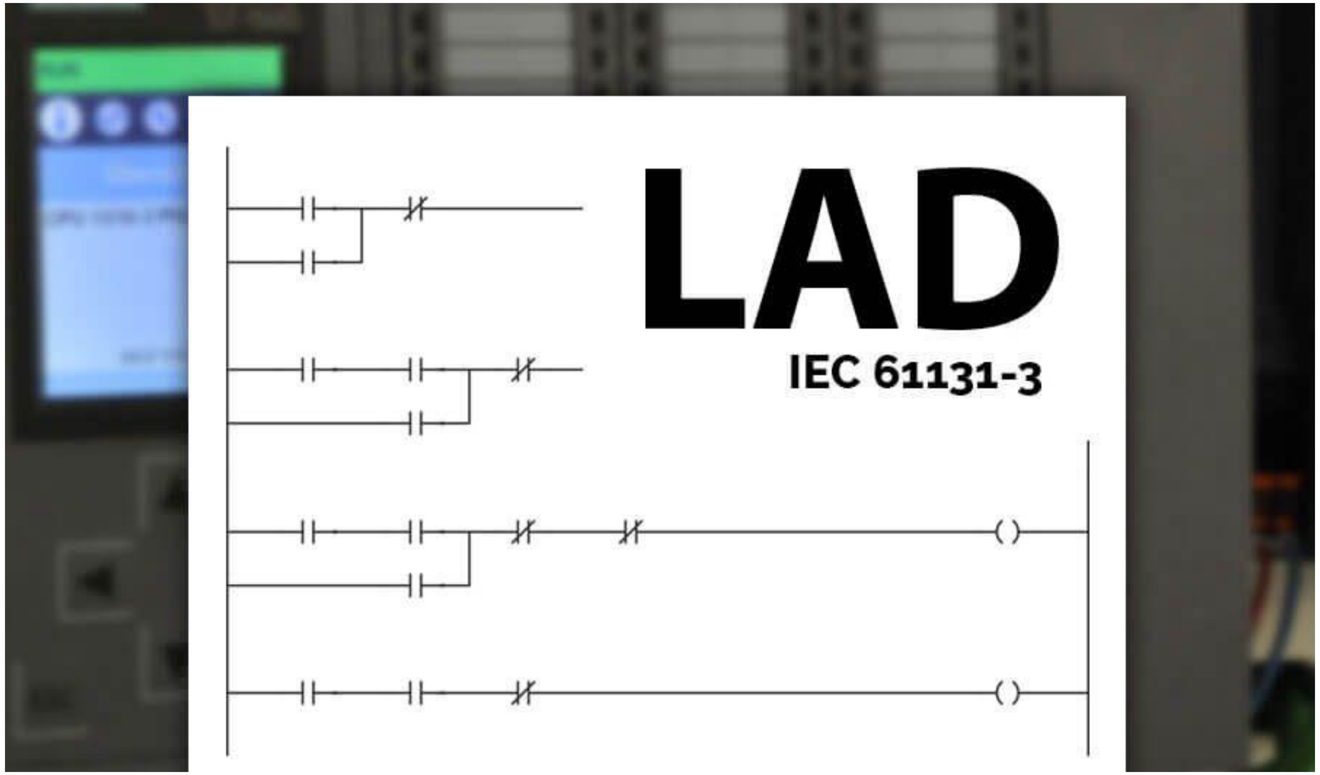


MAE 148 Autonomous Vehicles



- Learn to use motion and position sensors to control a car remotely.
- Algorithms for navigation. Programming the vehicle to follow the proper path.

ECE-40302



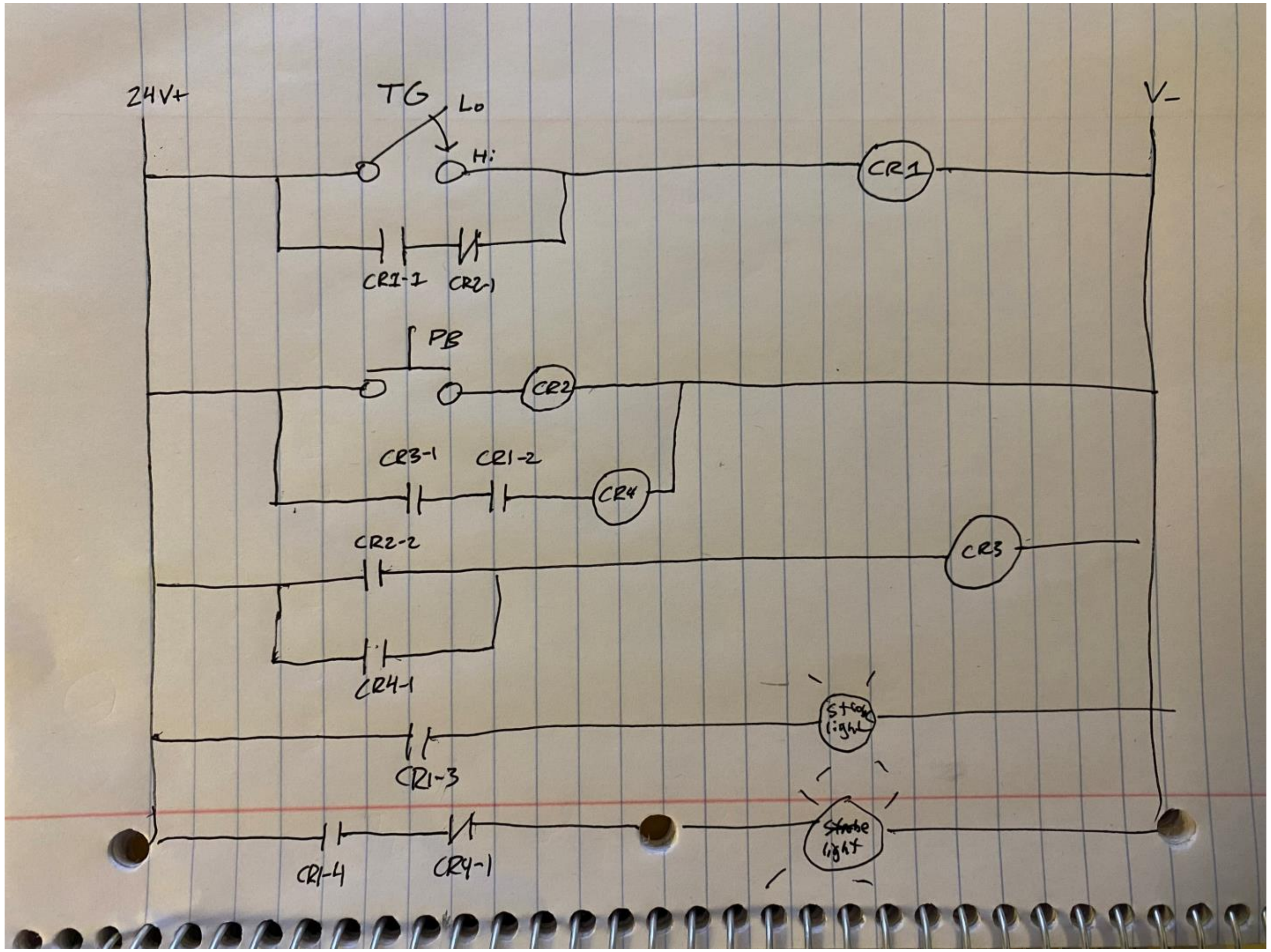
- Ladder Logic programming
- “Programming algorithms used to interact with motors, sensors, switches, networks, valves, relays and hydraulic and pneumonic systems”
- Focus is on Allen Bradley and Rockwell Automation software, although Siemens PLC’s will be explained as well. RSLogix software will be used along with LogixPro for simulation purposes.

Project Guidelines

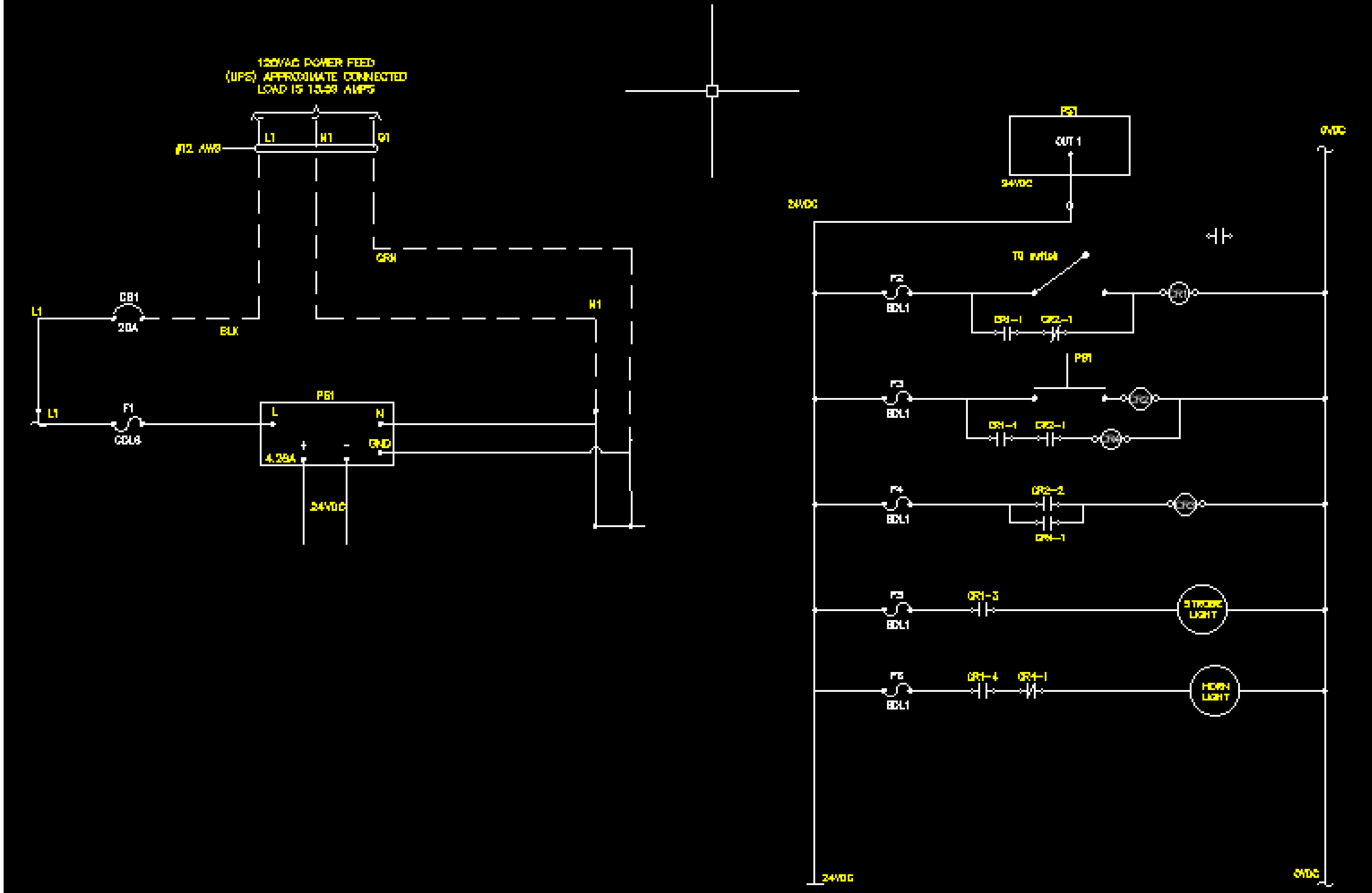
Design a NEMA 12 control panel meeting the following minimum requirements. The panel should be listable to UL 508A and is intended for installation in a temperature controlled space.

- The panel must contain power distribution to support the following:
  - 3x 120 VAC Class 1 circuits for internal panel loads.
  - 5x 24 VDC Class 1 circuits for internal panel loads.
- The following operators must be present on the panel door:
  - 1x Two-position maintained knob type – labeled “Lo” and “Hi”.
  - 1x Momentary push button – labeled “Reset/Silence”.
  - 2x LED pilot light indicators – labeled “Horn” and “Strobe”.
- The panel should implement hardware logic to achieve the following:
  - When knob operator is moved from Lo to Hi, Horn and Strobe indicators both energize. Both should stay energized even if knob returns to Lo.
  - When Reset/Silence button is pressed while knob operator is still Hi, Horn indicator should deenergize.
  - When Reset/Silence button is pressed while knob operator is Lo, Horn and Strobe indicators should both deenergize.

Rough draft



24V+
TG
Lo
Hi
CR1
CR1-1
CR2-1
PB
CR2
CR3-1
CR1-2
CR4
CR2-2
CR3
CR4-1
strobe light
CR1-3
CR1-4
CR4-1
Strobe light
V-



120VAC POWER FEED
(UPS) APPROXIMATE CONNECTED
LOAD IS 13.49 AMPS
L1
N1
#12 AWG
GRN
CB1
20A
BLK
L1
L1
F1
PS1
L
N
GND
+
-
24VDC
N1
PS1
OUT 1
24VDC
24VDC
0VDC
PB1
F2
F3
F4
F5
F6
CR1-1
CR2-1
CR2-2
CR1-3
STROBE
LIGHT
HORN
LIGHT
24VDC
0VDC

Questions?