

# NAU Mixing Valve Team

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# Project Description

- Our project is a mixing valve for General Atomics. There are two inlet ports and one outlet port to produce water that is at a specific temperature.
- The temperature is specified by the user and the valve mixes two streams of water to create the outlet stream of water.
- The goal is to reduce the weight of their current valve by a total of 96 lbs

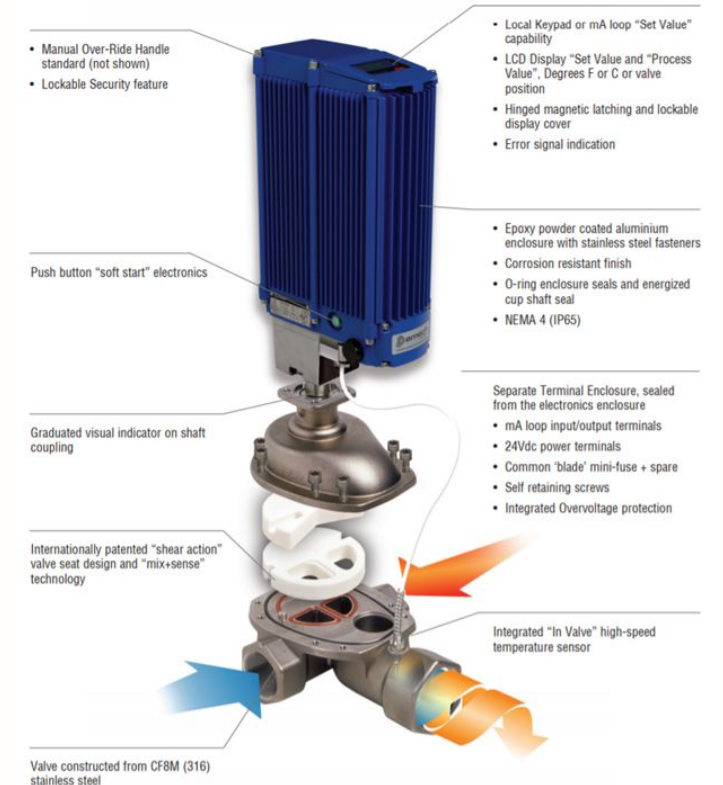
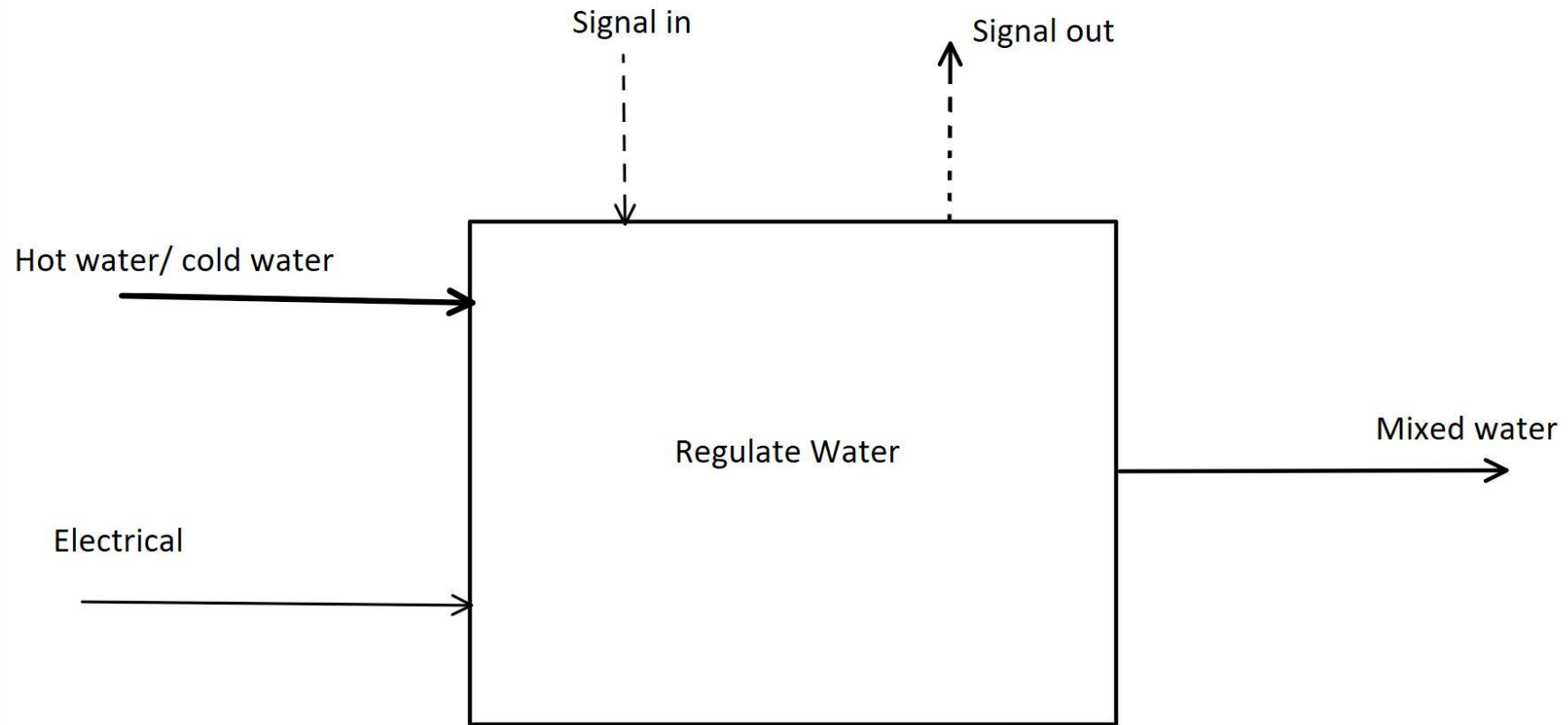
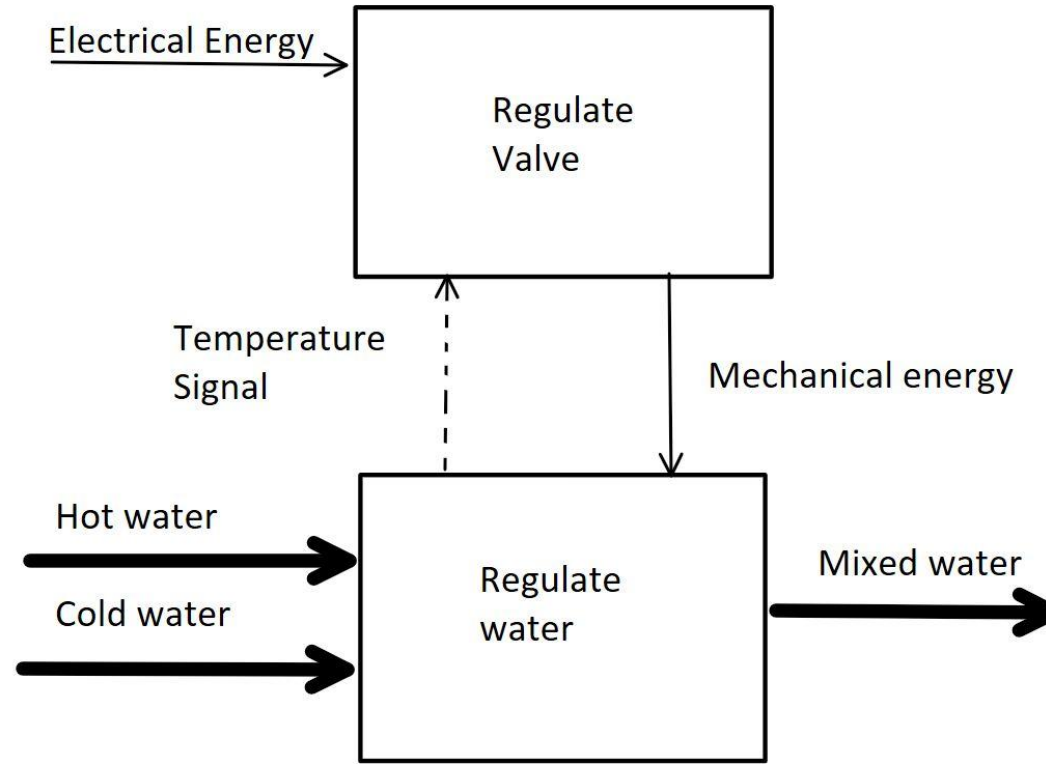





Figure 1: Modified Valve

# Black Box Model



# Functional Model



-  Material
-  Energy
-  Signal

# Concept Generation

- For Stainless Steel Valve Body:
  - With Flanges: 102.7 lbs
  - Without Flanges: 41.2 lbs.
  - **Weight reduced: 61.5 lbs.**
- For Titanium Valve Body:
  - With Flange: 57.9 lbs
  - Without Flange: 23.1 lbs
  - **Weight reduced: 34.8 lbs.**
- Total weight Reduction by switching to Ti and removing Flanges: 79.6 lbs

Material	Attachment Method
All Stainless Steel	Flanges
All Titanium	welds
Mix of Steel and Ti	Coupling/clamp

Figure 4: Concept generation freedom

# Why Switch to Titanium?

## Pros:

- Potential to use less material if re-constructing valve
- Titanium is non corrosive because it produces an oxidized protective layer
- Titanium is 56% as dense as Stainless Steel

## Drawbacks:

- Titanium has a modulus of 16ksi, whereas Stainless Steel has a modulus of 28000ksi
  - more material or re-structured part for same stiffness
- Titanium is more expensive
- Titanium is more difficult to machine

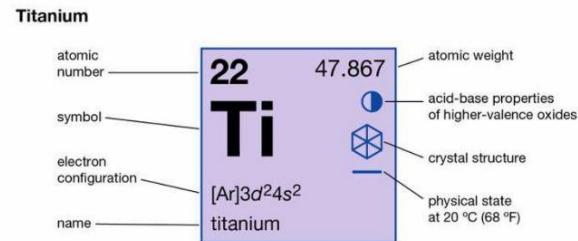


Figure 5: Titanium Information from Periodic Table

# Why Switch to Hydroflow Flanges?

- Hydroflow flanges can be used instead of original flanges
  - Three Flanges at exit/inlets are heavy
  - Reduce valve body weight by 61.5 lbs for stainless steel
- Can not weld stainless steel to titanium so welding is not an option
  - Hydroflow flanges can be machined with both titanium and stainless steel
- Hydroflow flanges act more as a coupling (Figure 6)

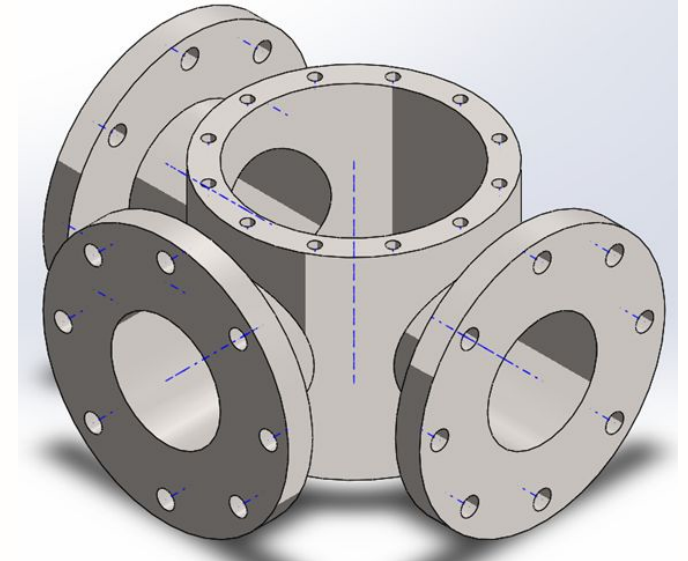
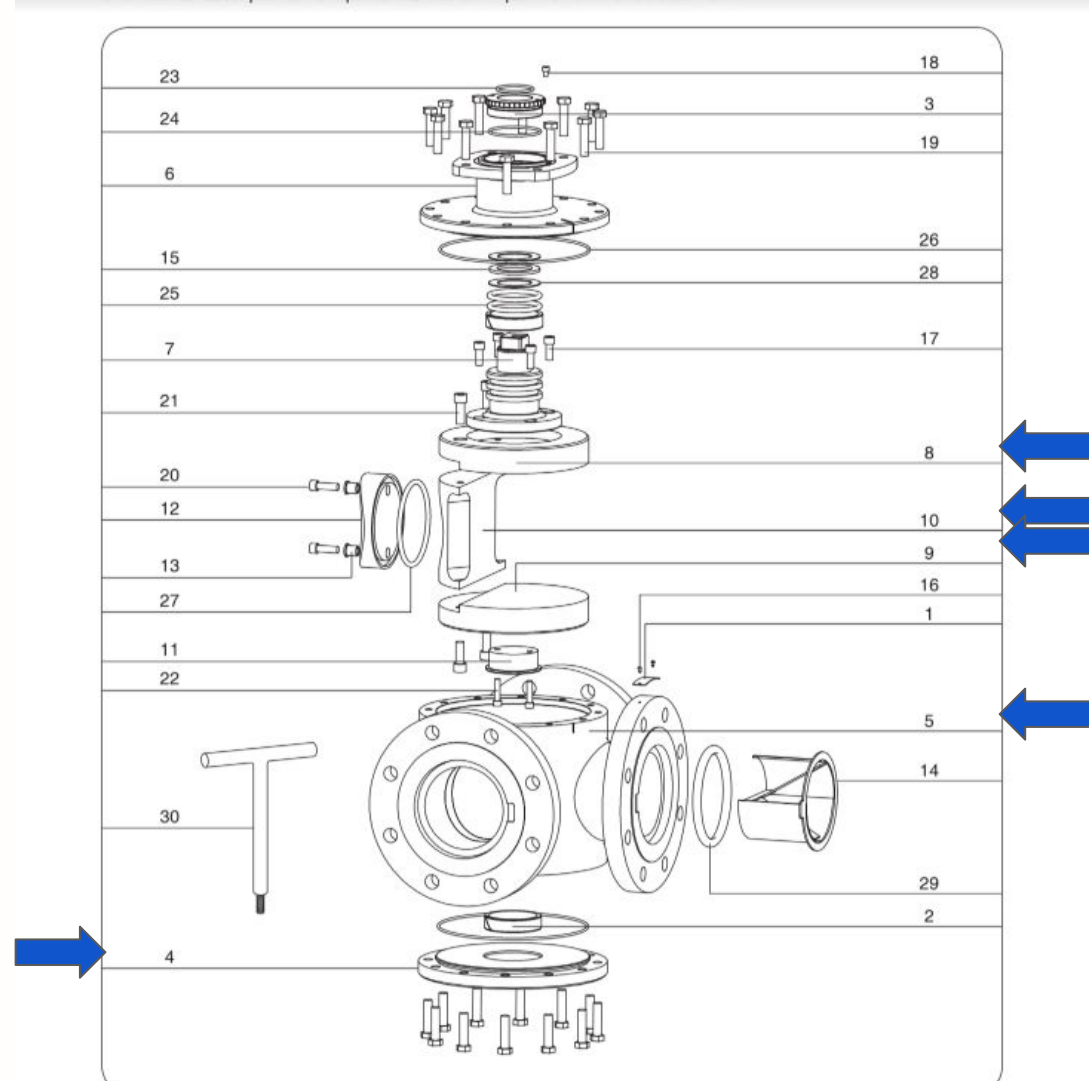


Figure 6: Un-Modified Valve



Figure 7: Example of Coupling

# Why Choose a mix of Steel and Titanium?



**Figure 8:** Exploded View of Un-Modified Valve



# Final Concept

- Mix of stainless steel and titanium
- Reduce machining cost
- Hydro-pressure couplings
  - No Flanges
  - Reduces weight
- Compatible with existing actuator
- Total weight reduction 79.6 lbs

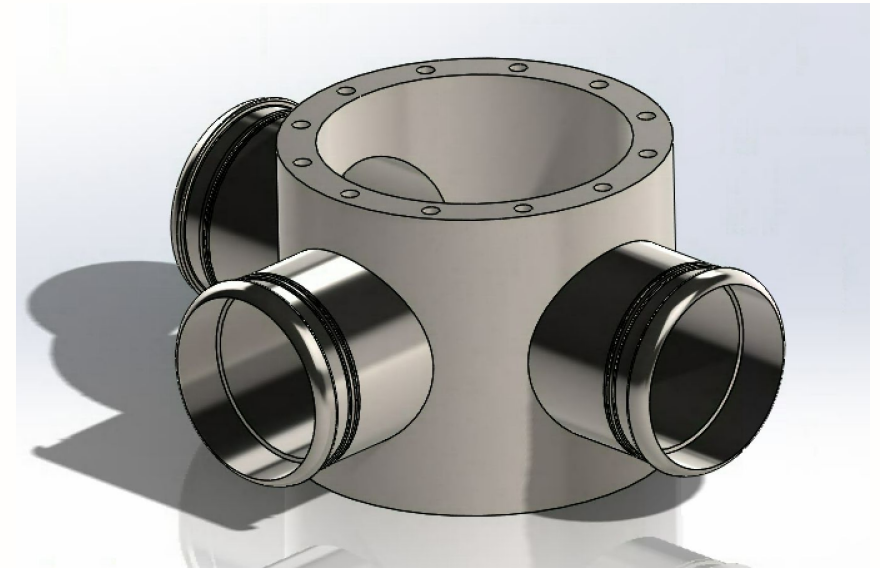


Figure 10: Valve Concept

# Budget Planning

- \$2500.00 available
- General Atomics will do all of our machining, so our budget will go to planning and prototyping 3D printed models
- No budget has been used at this time

# Future Work

- Topology Optimization
  - Affects flow
  - Internal component redesign
- Wall thickness
  - Reduce weight
- 3D Prototype

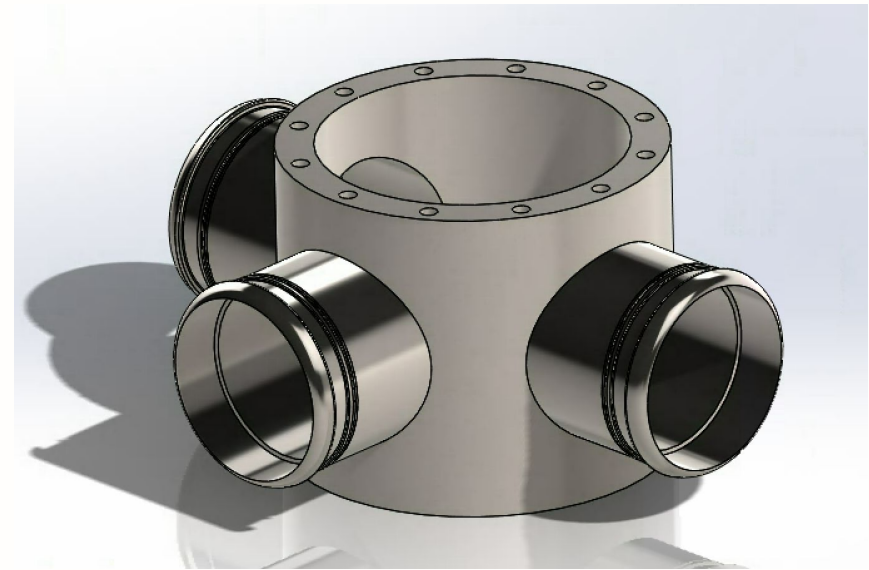
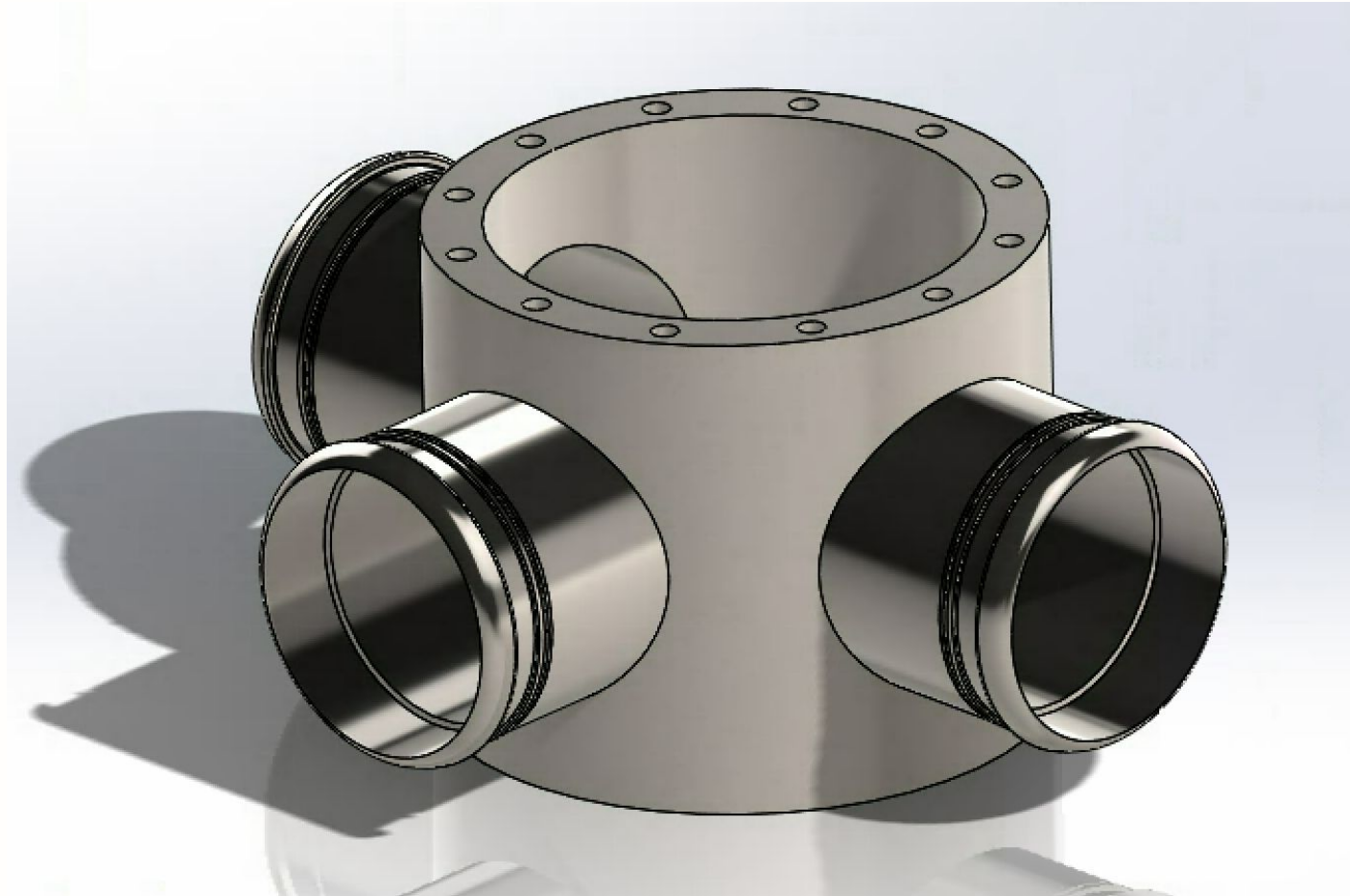


Figure 11: Valve Concept

# Questions?



# References

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- [2] Armstrong International, Inc. “Emech® Digital Control Valves.” *Armstrong*, 2017, [www.armstronginternational.com/sites/default/files/resources/documents/HW-430.pdf](http://www.armstronginternational.com/sites/default/files/resources/documents/HW-430.pdf). [Accessed: 05- Feb-2020].

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