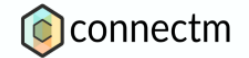


# CONNECTM MODEL 3 DAMPER UNIVERSAL REMOTE DAMPER

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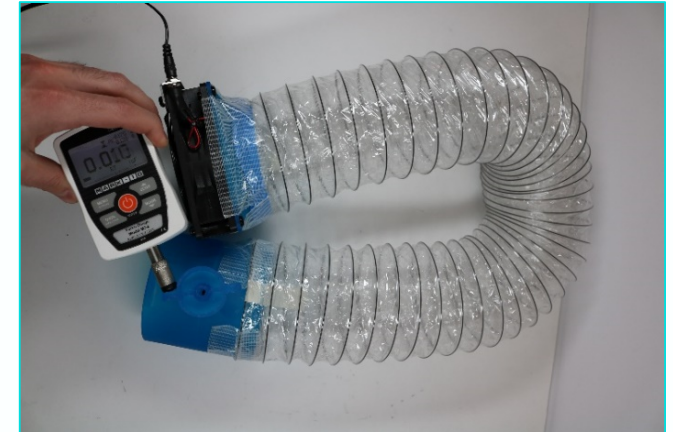
## Key Requirements



- Interface with standard straight vent HVAC boot (4", 6", & 8" diameter)
  - Sheet metal construction
  - 4" diameter vent chosen for layout
- Target Cost: ~\$20
- Target volume: 500k-1M units per year
- Operating Environment
  - Temperature: 0-85 C
  - Humidity: Standard HVAC
- Target Flow Rate: 0-125 CFM
- Target Pressure: 0"-2" H2O
- Low Noise
- Batteries:
  - 3-5 year life
  - User-accessible compartment
- Duty Cycle: 10 full open/close cycles per day
- Open / Close Speed: no specific requirement (slow speed OK)

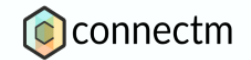
## Motor Torque Requirement Testing

- Motor sourcing exercise required evaluation of approximate expected open/close damper torque
- Off the shelf 120 CFM fan operating at 0.4" H<sub>2</sub>O used as airflow source.
- Rapid prototype damper and housing printed
- Torque range measured as follows:
  - Measured peak torque: 0.025 in-lbs (2.8 mNm)
  - 5x Safety Factor applied
  - Target motor torque: 0.120 in-lbs (13 mNm)



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# Motor / Drivetrain / Position Options



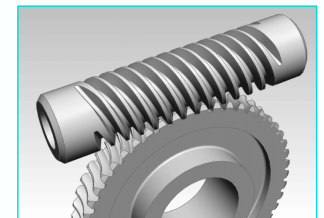
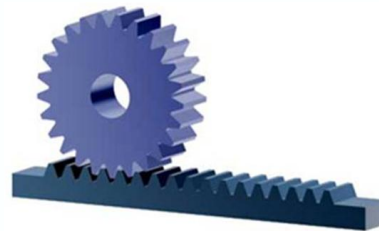
## 1. Drive Options:

1. DC Motor
2. Stepper Motor
3. Servo Motor



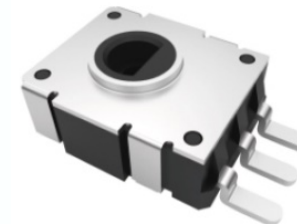
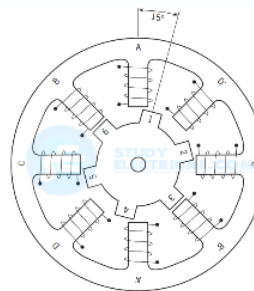
## 2. Drivetrain Options:

1. Worm Gear
2. Rack and Pinion
3. Belt Drive



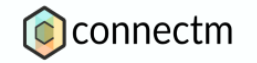
## 3. Rotational Position Sensor

1. Stepper with zeroing / calibration
2. Potentiometer with lookup value
3. Encoder direct on motor



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## HVAC Design Constraints

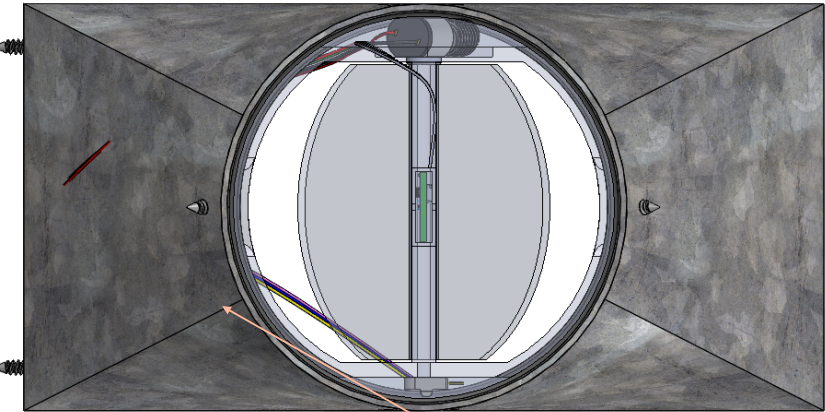
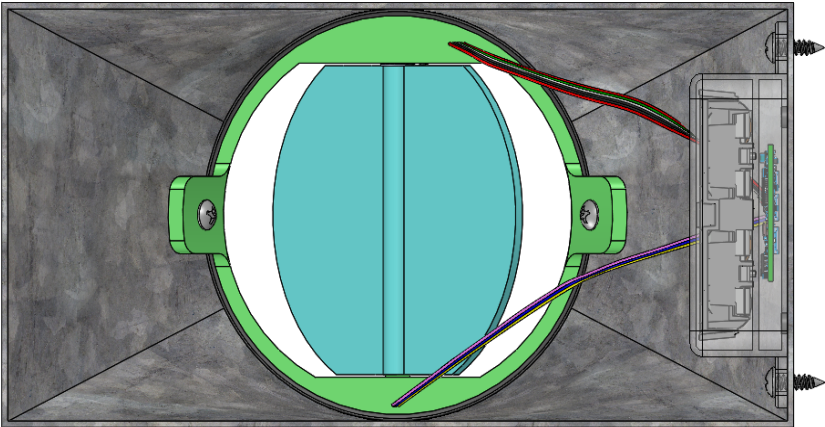


- 4" x 8" HVAC straight vent boot
- 4" Insulated flexible ducting



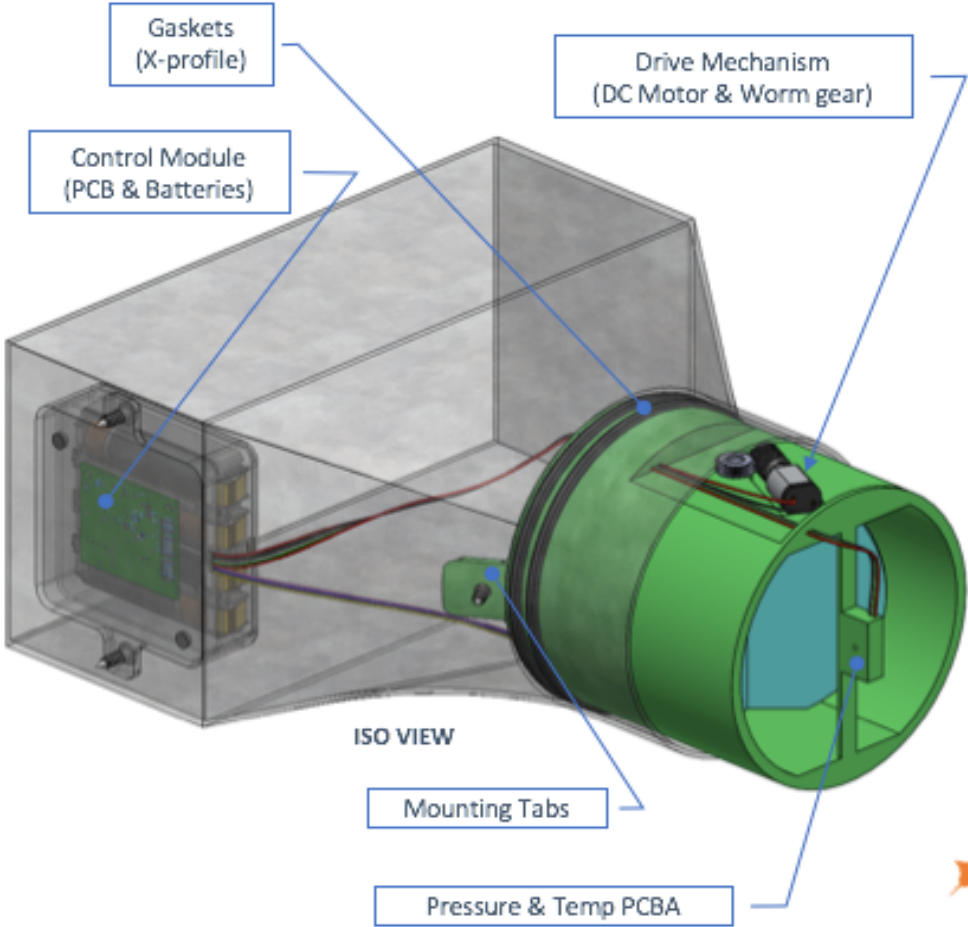


# CAD Layout Review



Potentiometer

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# Preliminary BOM Estimate



Level	Qty.	Component	Est. Cost (500k/yr)	Ext. Cost	Comments
<b>0</b>	<b>1</b>	<b>CONTROL MODULE ASSY</b>	<b>\$ 6.85</b>	<b>\$ 6.85</b>	
1	1	Control Module Housing, Bottom	\$ 1.00	\$ 1.00	Estimated for plastic injection molding
1	1	Control Module Housing, Cover	\$ 0.40	\$ 0.40	Estimated for plastic injection molding
1	2	Closure Magnets	\$ 0.05	\$ 0.10	Approximate Pricing from K&J Magnetics
1	2	Double (-) AA Clip Contact	\$ 0.20	\$ 0.40	Approximate Pricing from Digi-Key (MPD Devices part)
1	2	Double (+) AA Clip Contact	\$ 0.20	\$ 0.40	Approximate Pricing from Digi-Key (MPD Devices part)
1	1	PCB Control Assembly	\$ 5.00	\$ 5.00	Ecovent to confirm cost
1	4	AA Battery	\$ 0.10	\$ 0.40	Approximate Pricing from Digi-Key
<b>0</b>	<b>1</b>	<b>DAMPER ASSY</b>	<b>\$ 8.95</b>	<b>\$ 9.30</b>	
1	1	Pressure & Temp PCBA	\$ 3.00	\$ 3.00	Ecovent to confirm cost
1	1	Damper Housing	\$ 2.00	\$ 2.00	Estimated for plastic injection molding
1	1	Damper Valve	\$ 0.50	\$ 0.50	Estimated for plastic injection molding
1	1	Worm Gear	\$ 0.25	\$ 0.25	Estimated for plastic injection molding
1	1	Worm Drive	\$ 0.35	\$ 0.35	Estimated for plastic injection molding
1	2	O-Ring	\$ 0.35	\$ 0.70	Estimate for LSR injection molding
1	1	DC Motor	\$ 2.50	\$ 2.50	Based on discussions with Mabuchi and Nidec
1	1	Potentiometer	\$ 0.10	\$ 0.10	Based on discussions with Polyshine
<b>0</b>	<b>1</b>	<b>MOTOR WIRE HARNESS</b>	<b>\$ 0.25</b>	<b>\$ 0.25</b>	Estimate
<b>0</b>	<b>1</b>	<b>MEASUREMENT WIRE HARNESS</b>	<b>\$ 0.50</b>	<b>\$ 0.50</b>	Estimate
<b>0</b>	<b>1</b>	<b>POT WIRE HARNESS</b>	<b>\$ 0.25</b>	<b>\$ 0.25</b>	Estimate
<b>0</b>	<b>1</b>	<b>MANUAL ASSEMBLY</b>	<b>\$ 2.50</b>	<b>\$ 2.50</b>	10 min assy time estimate @ \$15/hr

**TOTAL BOM COST: \$ 19.65**

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