PROPOSED:
Modular Damper Standard

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Developed By:

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I. Project Overview

More Control

One can reduce HVAC energy consumption with more control. One can get control with $3 microcontroller IC's in physical devices networked together with reliable communication. Devices include:

- motorized dampers inside ducts
- motorized dampers at vent openings
- fans inside ducts
- motorized valves at radiators
- pumps that moves 60°F water from ground source into radiators and heat exchangers
- pumps that move water from thermal storage tank in basement into radiators and heat exchangers (water heated or cooled via solar when sun shining)
- sensors (occupancy, indoor/outdoor temperature, sun, wind pressure)

With the above technology, one can:

- more precisely control airflow from central HVAC fan
- move air from one room to another room while HVAC is off (e.g. move cool air from basement to warm office on 2nd floor without turning on central HVAC)
- route ground source 60°F water as needed
- route thermal storage water as needed
- integrate large appliances, thermal storage water, ground source 60°F water, and central HVAC

Devices with processors exist, yet we are not doing the above due to:

- a standard way to electrically plug the above devices into a building does not exist
- a common operating system for all devices that supports plug and play and reliable integration does not exist
- standard physical plug-in modules with fans and dampers does not exist

Researchers are working on the first two obstacles (standard electrical cable and operating system). For details, see: https://www.manhattan2.org/smart-building.

In this document we focus on the last remaining obstacle, which is a proposed standard for a replaceable standardized plug-in fan.

Standardization reduces cost via commoditization. Plug and play reduces cost via less design and installation labor.

One would want a system whose additional cost is paid for with reduce energy bills within a reasonable period of time. If one can do this, then mass adoption becomes feasible.

The good news is development costs are low, and a decent amount has already been completed. Perhaps the hardest part is the operating system (i.e. BuildingBus); however, this has already been coded and is available to others free and open. This means anyone can copy and modify at no cost.

Standard Plug-In Damper

If one places a proprietary damper or fan in a duct and it fails every 15 years while the building lasts 100 years, and the manufacturer stops production after 5 years, then the building will degrade in value due to difficult to obtain replacement parts. The only way to resolve this is to make use of standardized plug-in modules at vent openings.

For example, to replace a fan or motorized damper within a duct, one would remove the vent cover, reach into the duct, remove ~4 bolts, unplug the module, remove through vent opening, and replace with new standardized module, plug-and-play.

Students at Utah State University, set up by Dixon Nielson, developed this this. All design work is free and open, which means anyone can copy and modify at no cost. For details, see: https://www.manhattan2.org/fan-and-damper.

II. Physical Interface between Plug-in Module and Bracket

Mounting Interface

The mounting bracket is a permanent attachment in the duct. Figure 1 and Figure 2 show detailed views of the mounting bracket.

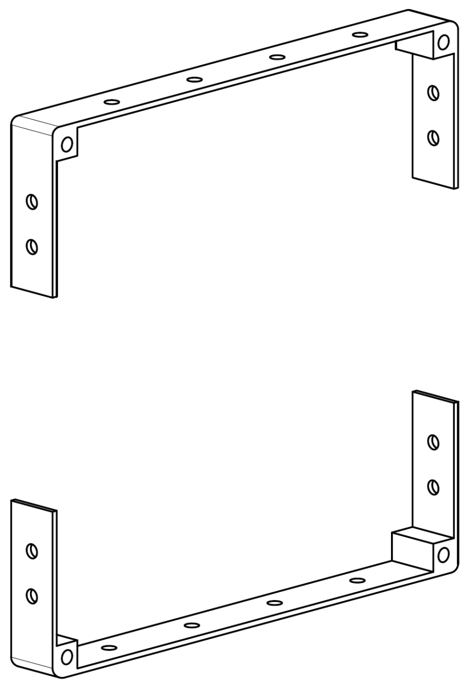


Figure 1. Mounting bracket.

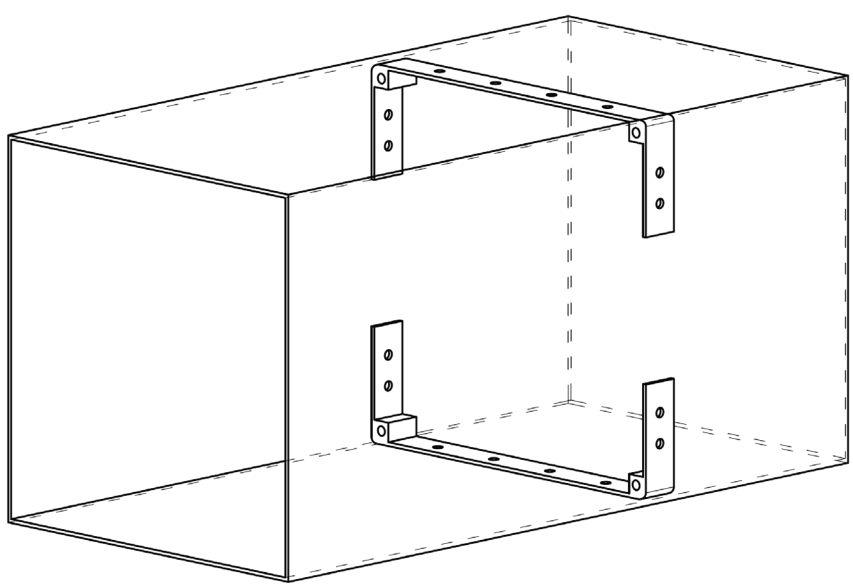


Figure 2. Mounting bracket inside of a duct.

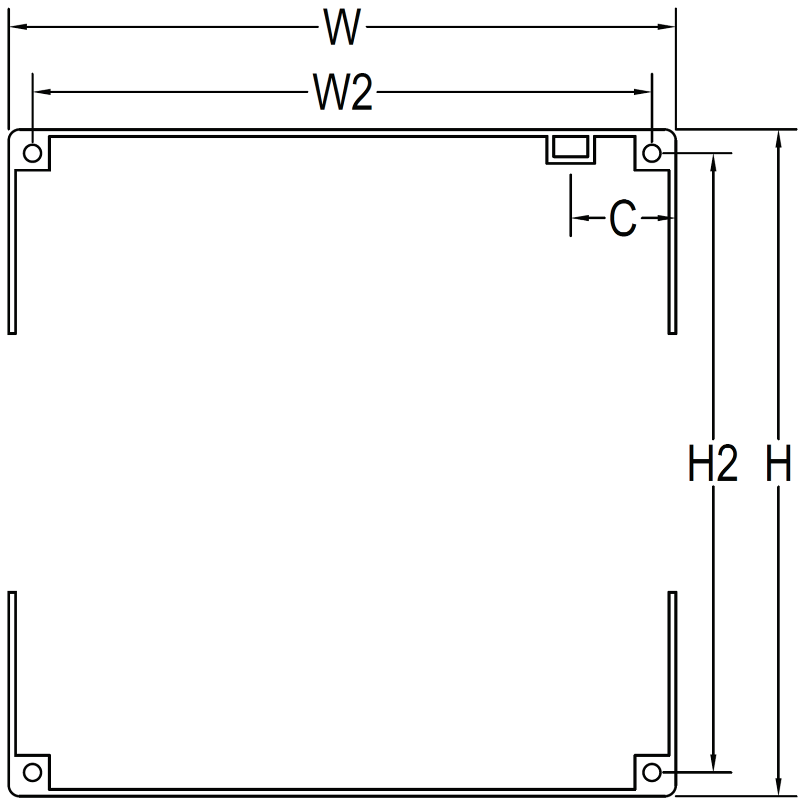


Figure 3. Bolt hole locations for mounting bracket.

Table 1. Dimensions in imperial units.

Duct Size (in)	W (in)	W2 (in)	H (in)	H2 (in)	C (in)	Threading
6 x 6	5.99	5.69	5.99	5.69	1.00	8-32
8 x 8	7.99	7.59	7.99	7.59	1.00	10-24
10 x 10	9.99	9.49	9.99	9.49	1.00	¼-20

Table 2. Dimensions in metric units.

Duct Size (mm)	W (mm)	W2 (mm)	H (mm)	H2 (mm)	C (mm)	Threading
150 x 150	149	141	149	141	25	M3-0.5
200 x 200	199	187	199	187	25	M5-0.8
250 x 250	249	235	249	235	25	M6-1.0

III. Interface between Plug-In Module and Duct

Plug-In Module

The plug-in module connects directly to the mounting bracket. Figure 4 and Figure 5 show one interpretation of the plug-in module.

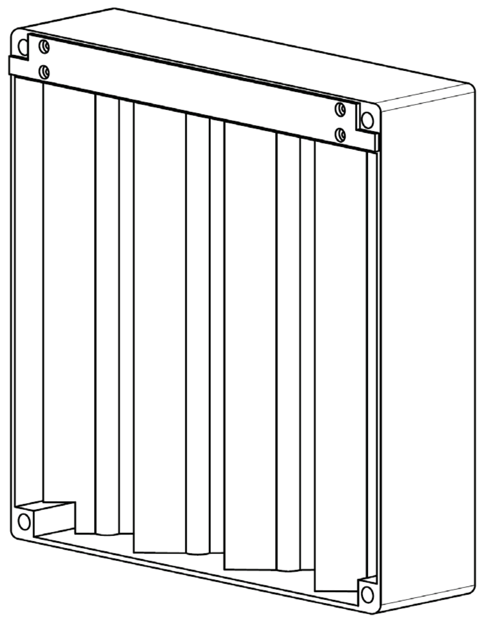


Figure 4. Plug-in module.

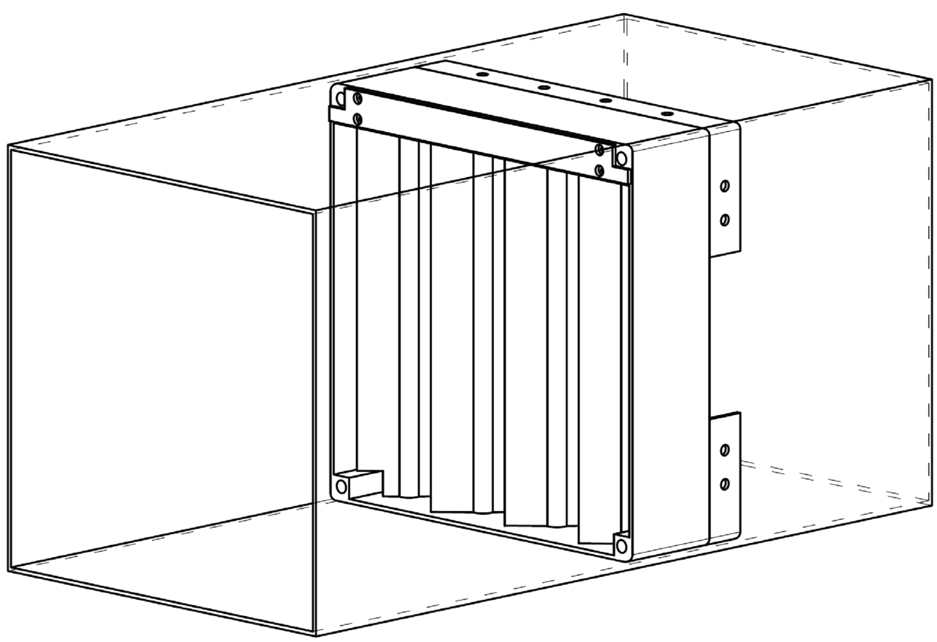


Figure 5. Plug-in module inside of duct.

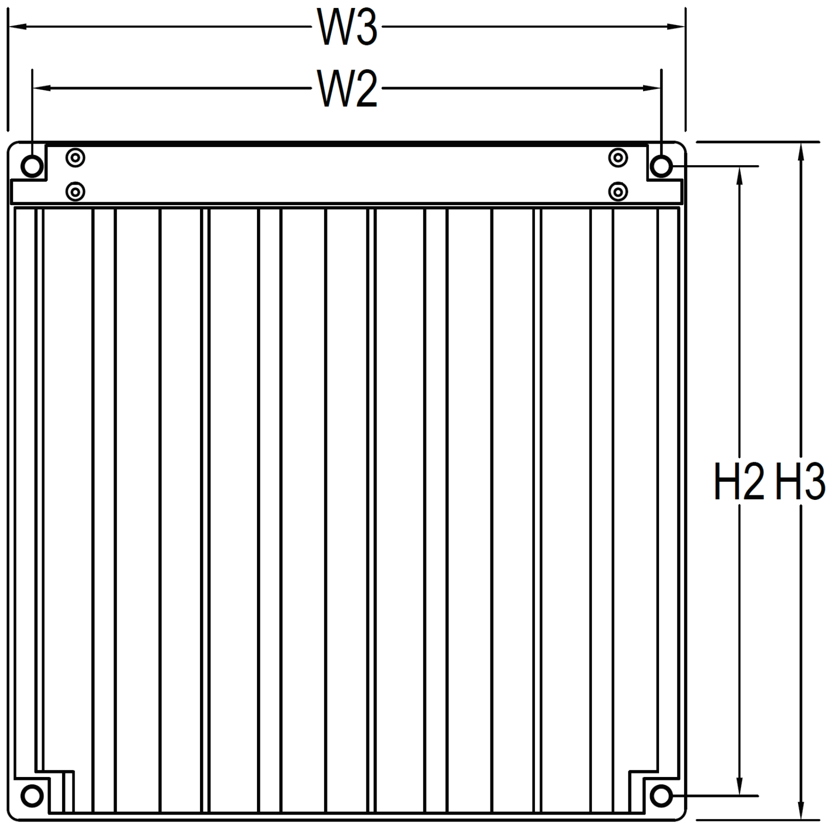
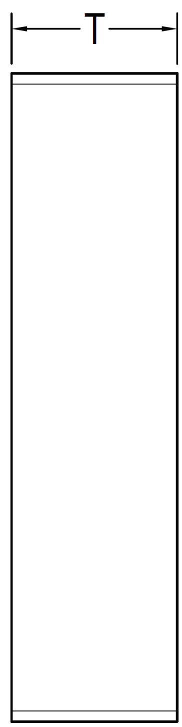


Figure 6. Front view plug-in module dimensions.



- **Figure 7.** Side view plug-in module dimensions.

Table 3. Dimensions in imperial units.

Duct Size (in)	W3 (in)	H3 (in)	T (in)
6 x 6	5.7	5.8	≤ 2.0
8 x 8	7.7	7.8	≤ 2.5
10 x 10	7.7	9.8	≤ 3.0

Table 4. Dimensions in metric units.

Duct Size (m)	W3 (mm)	H3 (mm)	T (in)
150 x 150	136	136	≤ 50.0
200 x 200	181	181	≤ 65.0
250 x 250	230	230	≤ 75.0