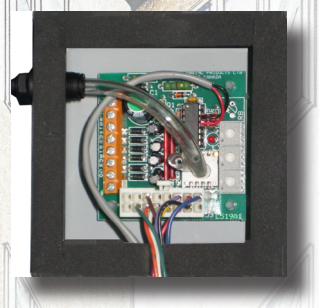
Hi-Velocity Systems™

Mini Duct Heating and Air Conditioning
Indoor Air Quality Systems

PWM (Pulse Width Modulation) Design Assistance



Manufactured By
Energy Saving Products Ltd.

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Pulse Width Modulation (PWM) Controller Design Layouts

Designing with the PWM Module

There are three basic layout styles to be used with the PWM controller: the Perimeter Loop/Branch, the Main Plenum Branch, and the Open Duct standard design.

The **Perimeter Loop** layout is as the term implies. A perimeter loop of plenum duct is installed in the structure, from there branch tees are installed for each zone dependant on the zone size, and a zone damper is installed for each take-off/zone.

The **Main Plenum Branch** method is similar to a Perimeter Loop, in that you direct the main plenum to the area loads, with branch tees directing each zone to the outlets, once again installing zone dampers.

The **Open Duct** layout is the same concept that is used in the ***Hi-Velocity Design Manual.*** This method utilizes the branch split and bullhead tees planning of air flow, with each zone being individually controlled.

Each basic layout has it's typical applications. For example, the Perimeter Loop and Main Branch Layouts are best served doing multi-zones of 4 or more, with the Open Duct best servicing 2 - 4 zones. Perimeter Loop works well in a single level application, while the Main branch is better suited for multi-level applications.

In some installations, it is necessary to reduce the size of the main plenum. Caution must be used when reducing plenum size, since smaller ducts can handle less number of outlets. Also keep in mind that once reduced, the main plenum cannot be increased again. The Branch Take Offs easily form to ducts in the 6" to 8" range; extra care must be taken with smaller sized ducts to ensure a proper air seal. For tee reductions, keep the tee to the full duct size, reducing only after the tee. Keep the length of the smaller duct sizes to a minimum, since the duct loss is much higher. If a hole saw will be used to drill the branch take-off holes, metal ducts are recommended to be 28 gauge steel.

Whichever method of zoning layout is utilized, it continues to be important for Indoor Air Quality that a certain amount of air is by-passed through each zone. This air recirculation is also important for Energy Efficiency, and even though the zone may not be calling for it, the recirc air will aid in overall living comfort.

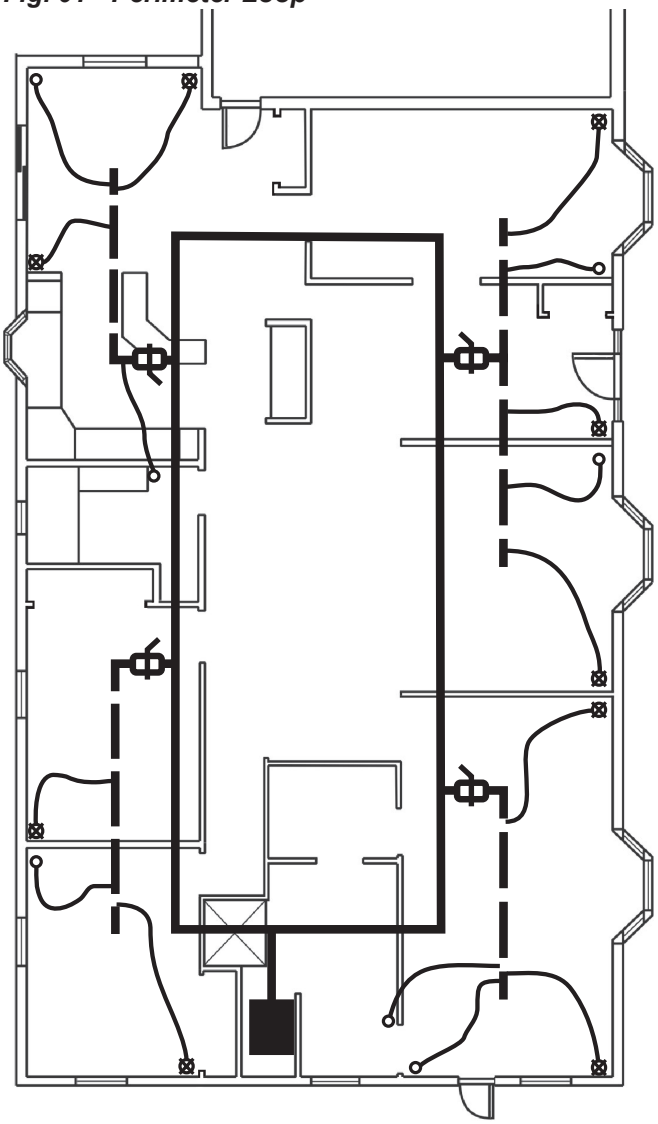
Perimeter Loop

When designing the perimeter loop, first determine the system load and individual zones. Locate the Fan Coil and vent outlets as per the design manual. Design the Perimeter Loop with the proper diameter 8" or 10" duct, as determined by the fan coil unit. Use appropriate plenum duct size around the perimeter of the structure.

When sizing the branch zone plenum off the Perimeter Loop, use the Zoning Duct Reduction Guide ***(Table 01)***. Total the outlets for each individual zone to determine the zone plenum duct diameter. Locate the tee servicing this zone to minimize the zone plenum duct, and run the plenum where it'll be possible to keep the AFD duct to 10' and 15' lengths. There is no minimum length on the Zone Main Plenum run. For maximum length allowed refer to the Zoning Duct Reduction Guide. ***(Table 01)***

Zoning Duct Reduction Guide			
Duct Size	# of vents (2")	# of vents (HE)	Plenum Max. Length
5"	6	3	40'
6"	12	6	50'
7"	19	9	60'
8"	29	14	70'
10"	50	25	100'

Fig. 01 - Perimeter Loop



LEGEND	
	Main Plenum
	Branch Zone
	HE Outlet
	2” Outlet
	HE and 2” Flex Duct
	Zone Damper

Main Plenum Branch

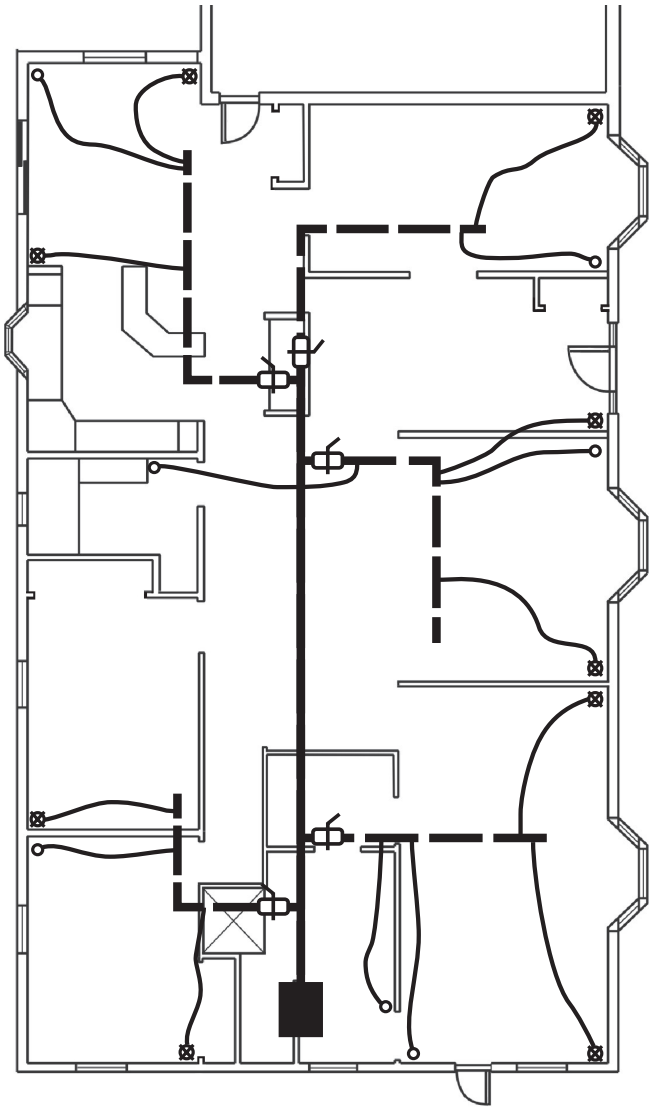
The Main Plenum also requires that a comprehensive system load is completed, zones determined, fancoil and outlets located as per the design manual. The Plenum duct is then located to direct the air to the loads at each zone, and elbow and tees can be located where required, as per the design manual.

The zone duct diameter is determined from the duct reduction guide ***(Table 01)*** and an appropriate balanced tee installed. Locate the tee servicing this zone to minimize the zone plenum duct, and run the plenum where it’ll be possible to keep the AFD duct to 10’ and 15’ lengths. There is no minimum length on the Zone Main Plenum run. For maximum length allowed refer to the Zoning Duct Reduction Guide. ***(Table 01)***

Table 01 - Zoning Duct Reduction Guide

Duct Size	# of vents (2”)	# of vents (HE)	Plenum Max. Length
5”	6	3	40’
6”	12	6	50’
7”	19	9	60’
8”	29	14	70’
10”	50	25	100’

Fig. 02 - Main Plenum Branch



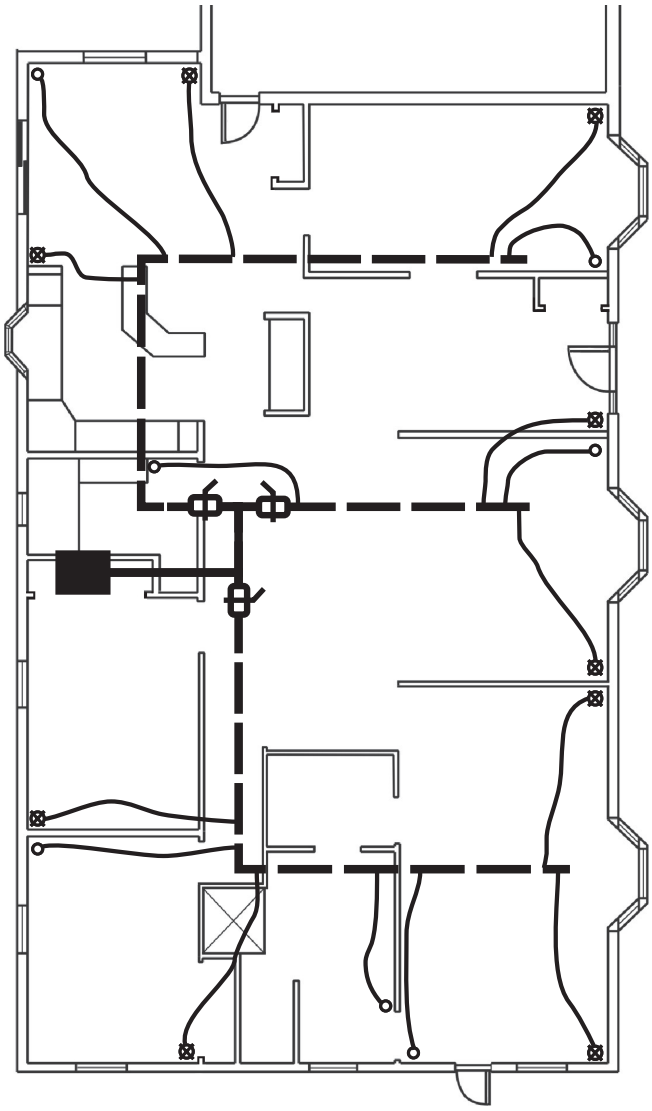
Open Duct System

The Open Branch layout utilizes the Hi-Velocity Design Manual in its entirety, from Load calculation to duct location. This method is best suited when 2 - 4 zones are utilized, by following the design manual and duct reduction guide if necessary. You will either branch or bullhead the tees to 1 or 2 zones, and continue the plenum to the furthest run, installing zone dampers where required.

Table 01 - Zoning Duct Reduction Guide			
Duct Size	# of vents (2”)	# of vents (HE)	Plenum Max. Length
5”	6	3	40’
6”	12	6	50’
7”	19	9	60’
8”	29	14	70’
10”	50	25	100’

The zone duct diameter is determined from the duct reduction guide ***(Table 01)*** and an appropriate balanced tee installed. Locate the tee servicing this zone to minimize the zone plenum duct, and run the plenum where possible to keep the AFD duct to 10’ and 15’ lengths. There is no minimum length on the Zone Main Plenum run. For maximum length allowed refer to the Zoning Duct Reduction Guide. ***(Table 01)***

Fig. 03 - Open Duct System



LEGEND	
	Main Plenum
	Branch Zone
	HE Outlet
	2” Outlet
	HE and 2” Flex Duct
	Zone Damper