



## IAV (INTELLIGENT AIR VOLUME) – THE EVOLUTION CONTINUES

*“It’s All About Turn Down”*

In the 1970s VAV (Variable Air Volume) systems replaced CAV (Constant Air Volume) systems. Concurrently, the 8-bit microprocessor with 4500 transistors was introduced. In the field of commercial HVAC systems, VAV systems became the first choice and were used as baselines for energy standards. Over the years, underfloor air distribution, low temperature and conductive cooling systems such as chilled beams, variable refrigerant flow, in- slab radiant were created to try to surpass the energy benchmark of VAV systems at 2-3 times the cost of a VAV system. Moreover, conductive cooling systems still require a DOAS (Dedicated Outdoor Air System). The inadequate turndown ratio of current flow measurement devices adds unnecessary pressure drop which increases costs, energy consumption, and noise generation, adds millions of part numbers/skews, engineering time and time to completion of a project that results in a dysfunctional business model.

The digital age revolution has made advancements in building technologies software and digital infrastructures. Today’s building technologies software is powerful and able to accomplish much more; however, interfacing into low turndown downstream zone devices limits the building technologies' software and digital infrastructure.

Can you imagine running today's computer software on an 8-bit microprocessor? Fundamentally, that is what is happening with today's HVAC systems and building digital infrastructures. Measuring fluids accurately, particularly low air flows at a reasonable price point have always been a challenge in the HVAC environment. Issues created by low turndown ratio devices start a domino effect that require "band-aids" to try to overcome the problems. Sound abatement devices are required due to the low turndown ratio, further increasing pressure drop and fan horsepower. In most cases, it becomes difficult to comply with the new updated standards and codes with the existing low turn down technology.

Flow measurement technology has stayed stagnant for the past 20 years. Innovation is a term used loosely by most entities. It usually involves a minor improvement to an existing product or value network. What is needed is Disruptive Innovation that can create a new market that will essentially reinvent an existing market and value network. With sustainability rising to heightened importance, there is a need for ground breaking disruptive innovation to improve building energy efficiency by orders of magnitude, not just incrementally, but at an economical price point.

Recently, the I9-9900K microprocessor made its debut which allows for computer software optimization at lightning speeds. Similar to the I9 -9900K microprocessor, the Intelligent Air Volume (IAV) system is a recent technological breakthrough in commercial HVAC systems that can achieve economical and accurate flow measurement over a wide, dynamic range. IAV systems are the next progression to VAV and conductive cooling systems. This advancement of VAV to IAV allows for full optimization of the digital building infrastructure and BAS software. The IAV system is conceivable by the HIGH TURN DOWN IDD’s (Intelligent Downstream Devices), utilizing patented advanced flow measurement and control technology.

The IAV system supplied by the BAS supplier per ASHRAE 195 is quiet, energy efficient/low EUI, features a 100:1 turndown, measures flow accurately at 2% down to 20 fpm, offers a minimal number of part numbers, and optimizes the building’s digital infrastructure with a simplistic single source business model. The IAV system provides the breakthrough technology that the current Commercial HVAC industry needs.



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A VAV device gives about a 4:1 turn down from 2000 FPM, with about  $\pm 25\%$  error at the low end of that range. Any unit not sized for 2000 FPM or more at design CFM gives proportionally less turndown or causes acoustical issues. In the face of these dismal numbers, recent advances in control hardware and software/programming capabilities are rendered ineffective.

IDD's feature a 100:1 turn down from 2000 FPM to 20 FPM; so 50:1 from 1000 FPM to 20 FPM. There is no longer either need or advantage to sizing units at 2000 FPM or more. Turbulent noise generation is proportional to  $v^5$  (velocity), so limiting velocities to closer to 1000 fpm automatically reduces noise by 15 dB. This degree of noise effacement is not practically achievable in the governing low-frequency bands by any other means: added system pressure drop and initial cost both put them out of reach.

IDD's eliminate hours of tedious design time attempting to size VAV units to meet their 2000 FPM requirement. The designer selects an IDD to meet the most difficult anticipated tenant zone requirement at  $\sim 1000$ fpm, then simply specifies that same IDD for all zones. Done in minutes, and even the worst case IDD has headroom to handle even doubling of the zone requirement. There is no performance penalty for oversizing the IDD's - In fact, they work better. Last minute change orders are eliminated when it's made clear that even the most difficult zone requirement can be doubled, and the lightest zone requirement halved or even quartered without entailing system redesign.

IDD measurement is accurate within  $\pm 2\%$  down to 20 FPM; Control is maintained all the way to 0 flow. Measurement becomes an increasingly relative figure as flow drops from 20 FPM to 2 FPM into the low Reynolds region. Even measurement off by 50%; 1 FPM at 2 FPM, is accurate to 1 part in 1000 of the full range when you are such low point so far below the nominal bottom of the measurement range. The IDD's enable implementation of a complete IAV system affecting MER coordination via a straightforward communication protocol between the central MER controller, all the IDD's, and the occupants served by each IDD.

High-performance thermal transfer units are available in both draw through and blow through configurations with low profile rectangular IDD's. The high turndown ratio allows for a cooling coil option, or combo heating and cooling coils for humidity control. The coils ship with factory installed piping packages, control valves or circulating pumps with ECM motors. The low profile IDD's with or without thermal transfer units begins a new era of advanced streamlined designs for Owners, Architects, and Designers, conceivable by this disruptive innovation.

The evolution continues. Whether it's the 8-bit microprocessor to the I9 microprocessor or a VAV system to an IAV system, there is always a necessity for a disruptive innovation. The IDD's that make the IAV system possible, lead the way to the evolution away from VAV and conductive cooling systems. IDD's enable accurate flow measurement and control over a vastly increased dynamic range (100-1 turn down) with negligible pressure drop; further, this allows engineers to easily and efficiently design and optimize the next progression of Digital IAV systems, through a single source controls supplier per ASHRAE 195, resulting in a high ROI.