Discharge Air Regulation Technique (DART™)

- **Large energy savings**
- **Easy to install**
- **Reliable**
- **Secure**
- **Low-cost**

Description:

Federspiel Controls has developed the Federspiel Advanced Control System (FACS™), which is a web-based, wireless, supervisory control system for commercial building HVAC systems. FACS includes a suite of control applications for large HVAC systems.

DART is the FACS application for converting constant air volume HVAC systems, particularly those that serve multiple zone, to variable air volume operation. The DART software, combined with the FACS wireless mesh network sensing and control modules, allow the system to be converted to VAV with no mechanical changes to the HVAC system.

Federspiel Controls has a patent pending for DART.

Benefits:

DART has the following benefits:

1. same savings as a conventional retrofit
2. minimal business interruption
3. avoid asbestos abatement
4. low cost

DART reduces the speed of supply and return fans, which reduces the energy consumed by those fans, and lowers the supply airflow rate. Reducing the supply airflow rate reduces the amount of cold supply air produced by the system, and reduces the amount of reheating or hot air produced by the hot deck of a dual duct system. The savings are achieved without compromising thermal comfort or indoor air quality. The amount that you will save depends on your system type, operating hours, and other factors. See the case studies on the next page for examples of energy saving potential.

DART installations are so non-intrusive that they can be performed by the building occupants work. The installation of each sensor requires just five to ten minutes per zone.

DART installations are significantly less expensive that conventional CAV to VAV retrofits. Simple payback is typically less than two years before rebates are applied.

The following table compares the benefits of DART to those of conventional CAV to VAV retrofits.

Comparison of Benefits

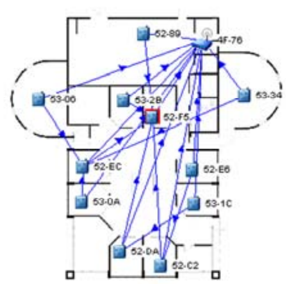
	Terminal retrofit	VAV diffusers	DART
Large savings	✓	✓-	✓
Non-intrusive		✓-	✓
Avoid asbestos			✓
Inexpensive			✓

Requirements:

DART is applicable to all constant volume HVAC systems. It can be applied to single-duct reheat, dual-duct, or multi-zone systems. It is compatible with systems that have pneumatic controls, legacy digital controls, or modern direct digital controls (DDC). We can integrate a FACS system running DART to your DDC system via BACnet or XML/SOAP.

How it works:

DART functions by modulating the fan speed so that either the highest discharge air temperature measured by a wireless temperature sensor is close to a high-temperature setpoint or the lowest discharge air temperature is close to a low-temperature setpoint. The system monitors hot deck and cold deck temperatures with wireless temperature sensors so that DART setpoints can track a hot deck or cold deck reset.



The first figure above shows an installation of a wireless sensor module used to measure discharge air temperature. The sensor module is clipped onto the t-bar ceiling, and an insertion probe is installed in the throat of the diffuser.

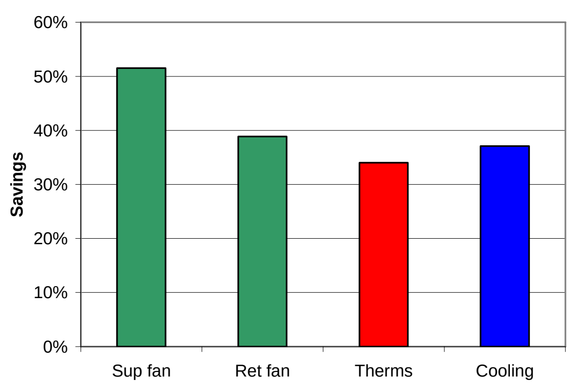
Each wireless sensor has a transceiver that supports self-configuring, seal-healing mesh networking. The network has N+1 redundancy as shown in the second figure above.

Case studies:

Energy Resource Station

DART was tested at the Iowa Energy Center's Energy Resource Station (ERS) in Ankeny, Iowa. The ERS is a test facility equipped with two nominally identical, heavily instrumented air-handling units that each serve four test rooms with nominally identical solar exposures. We ran one of the air-handling units as a constant-volume reheat system while the other was operated with DART for 10 days, then switched the roles of the air-handling units.

The following figure shows the average savings for the two tests. For a five day per week, 12 hour per day schedule, the savings were 1.85 kWh/CFM/yr and 0.17 therms/CFM/yr. Average zone temperature variability with DART was just 0.15 degF greater than the constant volume reheat system, and the largest zone temperature excursion occurred with the constant volume reheat system. On the coldest day of the test (28 degF outdoor air temperature at sunrise) and with just a 50 watt load in the test rooms (a computer with the monitor off), the ankle to head thermal stratification was still within the bounds of the ASHRAE thermal comfort standard.



UC Santa Barbara

FACS systems running DART were installed in four buildings at UC Santa Barbara. Eight air-handling units




were retrofit. Each air-handling unit is a dual-duct constant-volume design. All of the air-handling units had variable frequency drives on the supply fans before the retrofit. They were controlling supply duct static pressure to a fixed setpoint, which was producing constant flow because the resistance of the terminal mixing dampers is nominally constant. A detailed engineering audit was performed to estimate savings.

The figure above shows one of the hot deck temperature sensing modules. In most cases, the gateway for the wireless network and the supervisory controller were installed in the mechanical equipment room as shown to the right. Variable frequency drives were added to the return fans, and wireless control modules were installed on or next to the VFDs to command the speed of the VFDs over the air as shown below.

The bar chart below shows the electrical energy savings from a pre-installation to post-installation comparison. The figure doesn't show therms savings because the post-installation data were collected during the cooling season when the heat was off in all buildings.