THE ENERGY OBSERVER

Energy Efficiency Information for the Facility Manager

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Direct Digital Controls (DDC)

The Energy Observer summarizes published material about proven energy technologies and practices, and encourages users to exchange experiences with generic energy products and services. This quarterly bulletin also identifies informational sources and energy training for facility managers and staff. ***The Energy Observer*** is a service of the **Energy Office, Michigan Department of Consumer & Industry Services.**

DEFINITION

Direct Digital Control (DDC) is a type of energy management system. DDC is a form of closed loop control. A loop is a sequence of instructions, which are executed until a condition is satisfied. The term "Direct" means a micro-processor is directly in the control loop. The control is accomplished by digital electronics that read or control both digital and analog signals.

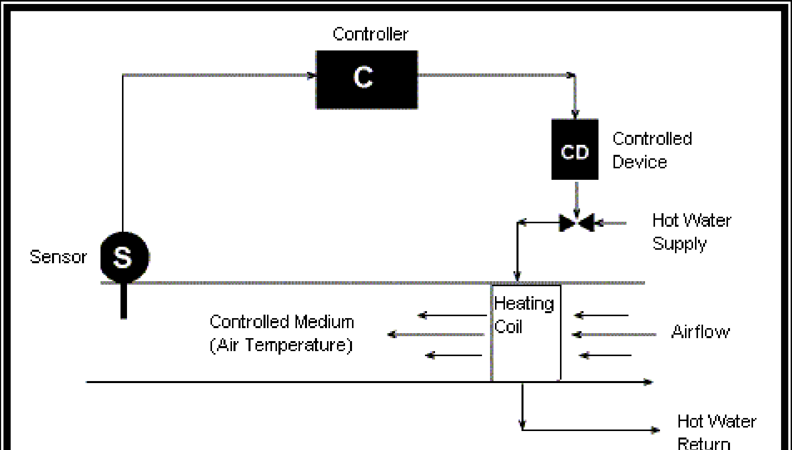
The three main benefits of DDC are improved operation, improved control effectiveness and increased energy efficiency.

CONTROL BASICS

Control in a HVAC system involves measuring and collecting data, processing the information and causing a control action. The components of system control include the sensors, the controller, the control loop and the data types.

Sensors measure controlled mediums or other controlled inputs in an accurate and repeatable manner. Sensors can measure (but are not limited to) temperature, pressure, relative humidity, time of day, electrical demand condition, airflow, fluid flow, electrical current, fire, smoke, and high/low limits.

The controller compares the input from sensors with a set of instructions such as set point, throttle range and required action. Then the controller produces an output signal that will cause the required action to satisfy the condition.



Basic Control Loop

Diagram was supplied by Iowa Energy Center

A control loop is the interaction between the sensors, the controller and the controlled devices. An example of a HVAC control loop would be indoor air temperature regulation. The sensor measures the indoor air temperature, and outputs the data. The controller processes the data and sends the output to the controlled devices causing the required action. Controlled devices may include but are not limited to valve operators, damper operators, electric relays, fans, pumps, compressors and variable speed drives.

Data types are digital, analog and accumulating. Digital (binary) data is an integer, a 0 or 1, and usually represents a state or condition such as on or off. Analog data are represented by a numeric or decimal number defining a varying electrical input that is a function of some variable. Accumulating data is also represented by a numeric or decimal number that is the resulting sum of some function. This type of data is sometimes called a pulse input.

Software Characteristics

Three common approaches are used to program the logic of DDC systems. They are line programming, template or menu-based programming and graphical or block programming.

Line programming systems use Basic or FORTRAN languages with HVAC subroutines. Being familiar with computer programming is helpful in understanding and writing logic for HVAC applications.

Menu-driven database or template/tabular programming use templates for common HVAC logical functions. These templates contain the detailed parameters necessary for each logical program block to function. Data flow, or how one program block is connected to another, is programmed into each template. In this type of software, less programming experience is required.

Graphical or block programming is an extension of template/tabular programming. Graphical representations of the individual function blocks are depicted using symbols connected by lines that represent the data flow. The process is depicted with symbols as on electrical schematics and pneumatic control diagrams. Graphical diagrams are created and the detailed data is entered in background menus or screens. This programming is very user friendly and virtually anyone familiar with HVAC systems can understand this type of programming.

Control Capabilities

DDC gives a building owner or operator many options for controlling the inside environment as well as the equipment operation in their buildings. DDC systems can be integrated with access/security control systems, fire control systems, lighting control systems, maintenance management systems and indoor air quality monitoring systems.

Strategies such as electrical demand monitoring and limiting can be more easily implemented with DDC systems. The overall electrical demand of a facility can be monitored and controlled by resetting various system set points based on differing demand levels. This could be accomplished by decreasing the requirement for cooling on a zone-by-zone basis.

Operational capabilities show the greatest opportunity for efficiency improvements with DDC. The ability for a system to signal an alarm if there is a problem detected is very useful. Many systems have the ability to route the alarms to various locations within a network for immediate response. Data and alarm histories can be stored and analyzed for trends in equipment performance over time. By storing trends, energy consumption patterns can be analyzed. These trending capabilities allow a diagnostic technician or engineer to troubleshoot for system and control problems. Equipment can also be centrally turned “on” or “off” in applications where schedules frequently change.

DDC technologies can reduce electric and/or gas costs by 20% to 50%, and maintenance costs by 40% or more.

Savings

With a DDC system, the savings in gas and electrical consumption can range from 20% to 50%.

Savings are also achieved in the maintenance of DDC systems compared to pneumatic systems. Pneumatic systems require constant monitoring and recalibration due to drifting. Drifting, or falling out of calibration, occurs in pneumatic equipment because of the interaction between air and mechanical devices. Drifting will not occur in DDC systems because digital signals, which are more accurate and reliable, have replaced the old pneumatic controls. System maintenance savings can be estimated at 40% or better.

For More Information:

Iowa Energy Center:
DDC-Online provides unbiased information on Direct Digital Controls (DDC) and an easy searchable guide to DDC manufacturers. www.ddc-online.org

Visit the Energy Office website for information on current programs, services and for past issues of ***the Energy Observer*** and grant information. Currently our website is being migrated to a new statewide format. However, all information from our former site is still available. The new URL is www.michigan.gov/energyoffice

If you have experience or data that you would like to share on this topic or if there is a topic that you would like to see discussed in a future issue of ***The Energy Observer*** please contact Brandy Minikey (contact information below)

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