

Farm Structures FACTSHEET



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MICRO-PROCESSOR (COMPUTER) CONTROL OF VENTILATION FOR LIVESTOCK AND POULTRY

Control of confined animal housing ventilation systems by micro-processor or micro-computer is an important development which has the potential to greatly improve environmental conditions in the barn. Micro-processor controls will soon be an essential component of any good heating and ventilation system.

ADVANTAGES:

- Eliminates manual control of air inlets, fans, heaters, etc.
- Optimizes the control of all equipment.
- Conserves energy since heating and ventilation rates are continuously adjusted to exactly match requirements.
- Improves environment, which leads to more comfortable animals and increased productivity.
- Provides the operator with important and useful information for farm management. Can also reduce time spent in the barn checking for satisfactory ventilation system operation.

DISADVANTAGES

- Systems are expensive to install (but prices will likely come down in the future).
- An investment of time is required for the farmer to learn how to use the system.
- The technology is rapidly developing. Today's systems may not be as good as tomorrows.

Micro-Processor control equipment varies from installation to installation, but the block diagram of figure 1 shows typical functions and relationships between the system parts.

There are two types of computer control systems (speaking in general terms):

1. **Self-contained** "in-barn" micro-processor; and
2. **Central computer** with satellite "in-barn" microprocessors.

A **self-contained** system is the simplest application. Such systems consist of a microprocessor control box which is located in (or near) the barn. Connected to the control box are electronic sensing devices that measure environmental conditions in the barn: e.g., temperature, building static pressure, relative humidity (RAH), etc. The barn environment is kept in the desired ranges when the microprocessor compares sensor readings to values which the farmer has put in its memory. The microprocessor then adjusts the fans, inlets and heaters for optimum operation.

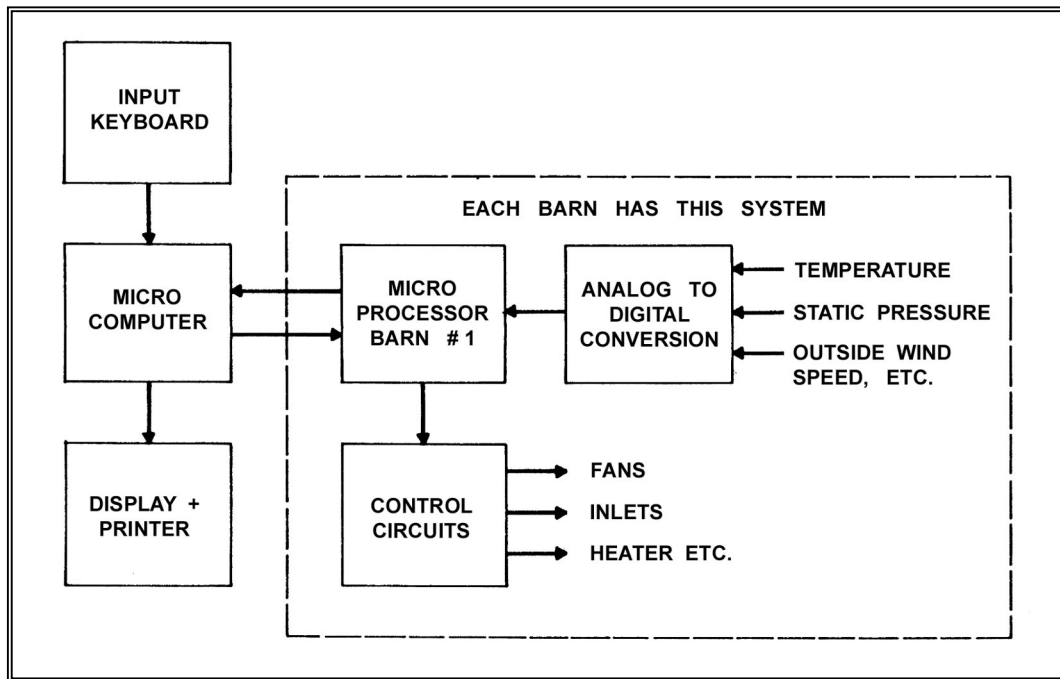


Figure 1

A **central computer** is a more sophisticated application that is suitable for multi-barn systems. The computer is located in the farm office and is connected to a microprocessor located in each barn. The barn environment is controlled as with the self-contained system, but the farmer also has a powerful management tool at his disposal. All of the barns can be controlled from the office where the video display terminal is able to show the farmer what the various barn temperatures are; what equipment is running and a whole range of other information.

An important point to remember about microprocessor control is that it is only as good as the building in which it is installed. Airtight construction, proper insulation and good ventilation design are all pre-requisites for optimum control of environment.

The best barn to put a microprocessor control system in is a new one. With new barns, much of the cost of a microprocessor system is offset because the conventional control system is no longer necessary. Retrofitting an old barn is more expensive for two reasons: first, the conventional system is usually discarded; and second, certain types of fans, inlets and heaters are more expensive to connect to the microprocessor. The important point here is **when considering microprocessor control, contact the control system dealer before ordering your heating and ventilating equipment – it can save you money.**

One of the problems with microprocessor technology is a lack of “barn-ready” products. No one is presently marketing a fully developed, off-the-shelf microprocessor control package for livestock and poultry applications. Such products will no doubt be available in the future. Presently, these control systems need to be custom designed and fitted.

OBJECTIVES OF THE SYSTEM

1. Measure air (dry-bulb) temperature accurately in the barn (more than one thermistor may be needed in order to obtain a reliable average temperature).
2. Measure outside air temperature. Outside wind direction and velocity are also desirable features.
3. Measure building static pressure and/or inlet air-jet velocity.
4. Measure inside and outside RH (either directly or by measuring the wet-bulb temperature).
5. Based on measured data, control operation of:
 - ♦ Fan staging
 - ♦ Heating system (brooder, heat lamps, floor heaters, etc.)
 - ♦ Cooling system (evaporative coolers, spray cooling, etc.)
 - ♦ Inlet adjustment to maintain constant jet velocity of 5 m/s
6. Store measured data in memory to provide the farm manager with:
 - ♦ Daily barn high and low temperatures
 - ♦ Daily barn high and low relative humidities
 - ♦ Daily barn energy consumption (energy units or hours of heater and fan operation)
7. Activate alarms for system malfunction:
 - ♦ Temperature too high or low
 - ♦ Power failure
 - ♦ Equipment failure
 - ♦ Computer failure

ADDITIONAL DESIRABLE FEATURES COULD INCLUDE:

8. Monitoring of:
 - ♦ Feed and water delivery system
 - ♦ Animal or bird weight
 - ♦ CO₂, NH₃, CO and H₂S concentration
 - ♦ Energy consumption of fans and heaters
9. Control of feed delivery based on animal performance, age, temperature, stocking density or other variables.
10. Provide extensive information to the farmer on environment and animal performance:

- ♦ Daily graphs of temperature, RH, gas concentration, etc.
 - ♦ Compute daily or weekly feed conversion ratios of animals or birds
 - ♦ Predict feed requirements for ordering purposes
 - ♦ Continuous display of all measured variables
 - ♦ Display what equipment is operating
- * Measurement of RH and gas concentration is unreliable with present technology. Such sensors are expensive and adversely affected by the dust and chemicals present in most barn environments. Until these instruments are improved, control of equipment should not be based on these parameters.

The objectives listed as points 1 to 7 are all features, which the farmer should expect to see. Points 8 through 10 are bonus features, which may or may not be available depending on how much money, one is willing to spend. Some people have speculated that barns will soon be fully controlled by computer. Eventually full computer control may become a reality but such systems are still far too expensive to be economical.

UNDESIRABLE FUNCTIONS

The following are things the microprocessor should not do:

- ♦ Run variable speed fans at less than 20-25% of full speed.
- ♦ Run heater and “greater than minimum rate” fans at the same time (minimum rate fans are always on – but if extra fans and heaters are run simultaneously, heat is being wasted).
- ♦ Cycle minimum rate fans on and off
- ♦ Shut inlet vents off completely. Inlet air-jet velocity should be controlled to 5 +/- 1 m/s.
- ♦ Control ventilation rate on the basis of RH (instruments are too unreliable for use as a control parameter; RH should only be monitored).

DESIRABLE PROGRAMMING CAPABILITY

All micro-processors allow the operator to tell it what it should be doing. Some systems are easier to operate than others, and most farmers are not computer experts. Look for a “user friendly” system that is simple to operate and allows flexibility in setting desired barn temperatures.

- Ability to set system for any reasonable temperature.
- Ability to set temperature to increase or decrease continuously over a certain time period (e.g., slowly lower temperature in a broiler barn).
- Ability to set alarm temperature.
- Ability to set barn static pressure or inlet air-jet velocity.
- Provide for manual override of the micro-processor.

USEFUL TERMINOLOGY

A/D converter means “analog to digital converter”. Readings from instruments need to be converted from analog to digital form so that the computer can understand them. The term is usually stated as an “8-bit A/D converter”.

RAM stands for “random access memory” and is measured in kilobytes. RAM is an indication of computing power.

I/O channels stands for “input-output channels”. Input channels are required for plugging sensors into the computer and output channels are required for connecting equipment to the computer. The control capacity of the system is limited by the number of channels.

COSTS

The cost of a micro-processor is quite variable depending on what features are desired and how difficult an existing barn is to outfit. Approximate price ranges are suggested below.

Simple one-barn system, no extras:

\$3,000 - \$6,000

One-barn system with central computer:

\$5,000 - \$8,000

Six-barn system with central computer:

\$18,000 - \$25,000

COMPANIES TO CONTACT

At the present time, there are only two British Columbian firms that specialize in farm microprocessing control systems. Both of these companies have extensive experience with microprocessor installations in greenhouses, but are relatively new to livestock and poultry systems.

Argus Control Systems Ltd.

1281 Johnston Road

White Rock, BC

V4B 3Y9

Phone: (604) 538-3531

Fax: (604) 538-4728

Priva Computers Ltd.

109-19425 Langley By-Pass

Surrey, B.C.

V3S 6K1

530-0277 or 530-0278

Both companies have stock equipment adaptable to barn control systems that will require some custom fitting. Both companies are also developing “barn-ready” products which should become available in 1985-86.

FOR FURTHER INFORMATION CONTACT

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