INFORMATION GUIDE

Controls and Monitoring

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MITSUBISHI ELECTRIC
LIVING ENVIRONMENTAL SYSTEMS

Guide to Controls and Monitoring

This is an independent guide produced by Mitsubishi Electric to enhance the knowledge of its customers and provide a view of the key issues facing our industry today. The guide accompanies a series of seminars, all of which are CPD accredited.

The changing face of construction in the 21st century demands that designers, specifiers and suppliers work as teams to create better buildings for occupants and the environment.

Mitsubishi Electric aims to be a part of this by encouraging employees and customers to work together to increase their knowledge of the latest technology, legislation and markets.

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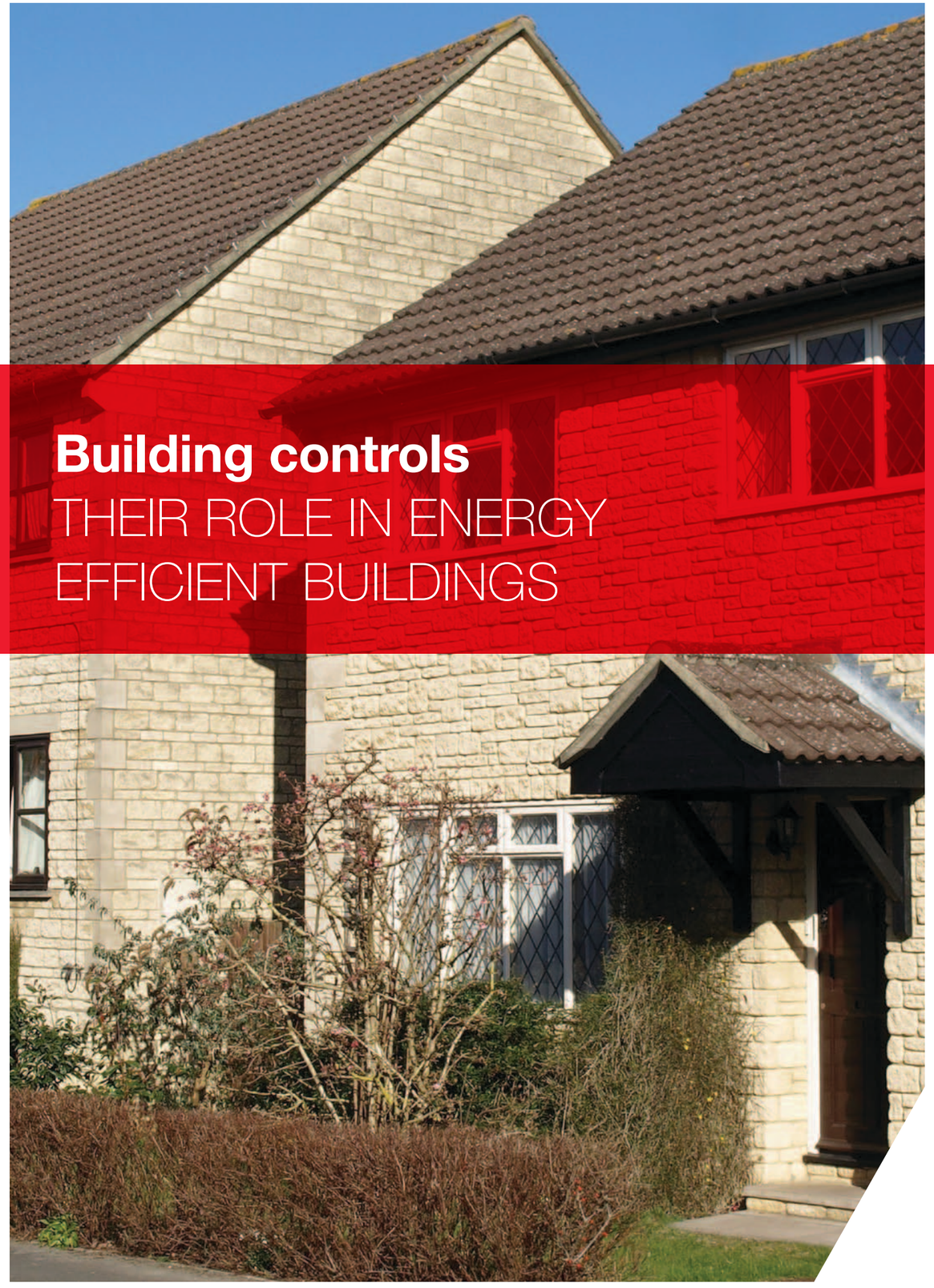


Building controls
THEIR ROLE IN ENERGY EFFICIENT BUILDINGS

*1: Carbon Trust publication Building controls technology overview (CTV032)

This is downloadable free from the website **www.carbontrust.co.uk**

In recent years, manufacturers of building services equipment have developed their products to reach ever-higher levels of energy efficiency. Specifiers can now select from a wide range of products that offer highly energy efficient methods of heating, ventilating and cooling buildings.

However, no matter how energy efficient the building service equipment is, it cannot operate at maximum efficiency without controls. Controls influence every aspect of a building's operation – heating and hot water; ventilation; cooling and air conditioning; lighting; windows and shading. This means that controls can monitor and control every kilowatt of energy used by the building at all times.

The facts about buildings that do not have building controls, or where they are poorly used, clearly demonstrate the effect that controls have on energy use. The Carbon Trust states (*1): "Poor control of heating, ventilation, cooling and lighting is responsible for excessive consumption in many buildings." In premises with well-controlled systems, heating bills can be 15% to 34% lower than in poorly controlled buildings. By the same token, inadequate or incorrect application of boiler control can easily add 15% to 30% to fuel consumption, when compared with a boiler which is properly controlled.

For air conditioning systems, controls are vital for correct and efficient operation. Controls on an air conditioning system will optimise performance and minimise running costs. Operating an air conditioning system without the right control can prove costly. For every degree that the system deviates from the required temperature, energy costs can rise by 5%.

There are additional benefits to ensuring correct control of air conditioning systems. Controls limit wear and tear on systems and plant. They also minimise maintenance, repair and replacement costs. These factors mean a longer life for equipment and reduction of waste from construction work due to early replacement.

Controls are a highly scalable technology. It is possible, but not necessary, to specify a complex building management system (BMS)

that links together all building services plant in one system. Specifiers can opt for something simpler, to suit the project budget. There are controls for every type of building, and a range of options available for the specific control of air conditioning systems.

Controls also offer a high degree of flexibility. They are now generally fitted to new buildings, but they can also be extremely useful in reducing the energy use of existing buildings. With wireless technologies, retrofitting has become much simpler and older buildings can benefit enormously from better controls.

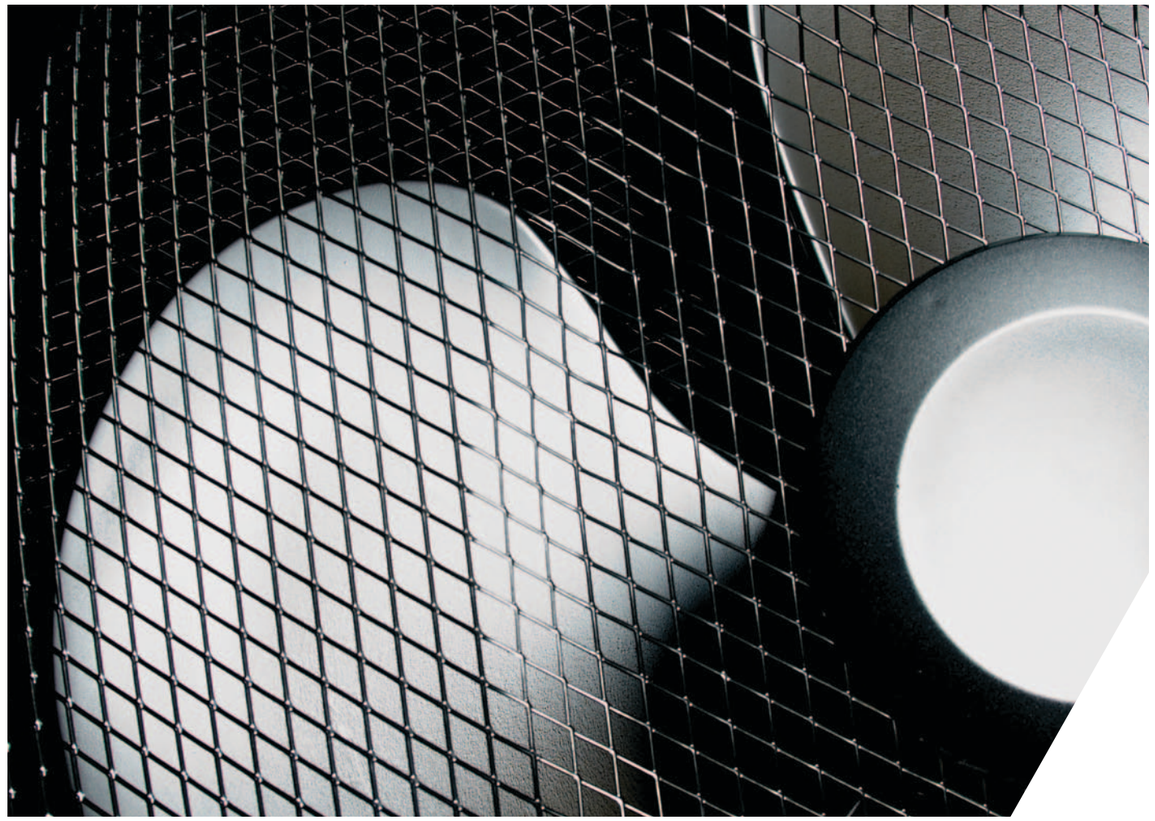
As we look to the future, more buildings will make use of renewable technologies and passive design features. Again, building controls are an absolute necessity for these systems. For example, mixed-mode buildings that use a combination of natural ventilation and air conditioning rely entirely on a building control system to maintain the balance between occupant comfort and energy use.

As energy efficiency becomes a more important issue for many businesses, specifiers and facilities managers are looking for cost-effective ways to reduce energy waste. Building controls offer excellent return on investment, and as controls technology has developed, it is much easier to retrofit new controls in an existing building. Perhaps most importantly, using an existing control system correctly can create immediate energy and cost savings. Our next feature examines some of the types of control that are available today.

Energy saving strategies

Effective use of the controls on an HVAC system can reduce energy consumption, running costs and improve occupant comfort.

- Make sure you have the right level of control for your building size and type.
- Make the most of user manuals to understand what features your controller has, and use them to gain better control of the HVAC system
- Set time controls to turn off at nights, weekends and bank holidays – whenever the building is unoccupied.
- Someone should have responsibility for monitoring HVAC control systems to avoid incorrect use.
- Thermostats should be positioned correctly – avoiding direct sunlight, or being placed above heat-generating equipment such as photocopiers.
- Avoid operating heating and cooling simultaneously.
- Avoid opening windows while heating a room.
- Reduce the thermostat point temperature whenever possible (for example in meeting rooms that are often unoccupied).
- Lower the Set Point in winter, as occupants benefit from the difference to outside temperature. Raise the Set Point higher in summer.



Building controls

A FLEXIBLE OPTION

There are a number of steps that can be taken to ensure that end users see the full benefits of a control system. For example, there are many types of HVAC system controller, with varying levels of sophistication. Identifying the correct controller requires a careful consideration of the size of building and how it is used.

The ability to respond to different building requirements is particularly important for air conditioning systems. They must react to a variety of factors including different room sizes, usage and occupancy levels as well as heat loads from electronic equipment and lighting. Optimum control of air conditioning systems is therefore essential to ensure a constant, comfortable environment, which is both energy- and cost-efficient.

For example, in a small office a simple control system with a wall-mounted interface to control ambient

temperature and on/off scheduling will be sufficient to achieve the optimum level of running costs and energy efficiency. However, in a large hotel, a much more sophisticated computer-controlled system will be appropriate to implement more intricate control strategies and to coordinate a large number of HVAC units. Manufacturers should be able to offer good advice on which of their control units is suitable for the specific project, so it is a good idea to involve them in the early stages of design.

Rather like IT equipment, controls technology is constantly developing so that more features are available on smaller and less costly models. For example, Mitsubishi Electric developed a new I/O interface introduced in September 2010, offers two energy saving modes which were previously only available on more expensive control solutions.

Developments such as this mean that better control of air conditioning systems is now available even in the small office market. Energy saving functions such as 'Auto off' can set the auto mode for a predetermined period of time before reverting back to fan-only to save energy. This means that the air conditioning could be set to turn on at 8am, run for two hours and then switch to fan-only mode.

Smaller control units can now also allow users to use 'Set Point' functionality. The air conditioning is activated by the internal temperature, with the fan only running until the internal temperature falls or exceeds a specified temperature for example below 19°C or above 23°C.

However, simply installing the correct controls is only one step towards reducing HVAC system energy consumption and running costs. How the controls are used after installation is equally important. Users must understand how to access the benefits of energy-saving functions, and how to use the controls to ensure long-term energy efficiency.

For example, with the two simple functions mentioned above, Auto Off and Set Points, it is possible to develop a sophisticated controls strategy that responds to how the building is used and to external temperatures. Using these functions, the air conditioning can be set to switch on at 8am, but will only operate if the internal temperature drops below or exceeds predetermined limits. Thus, the air conditioning is responding to both occupancy of the building and internal temperatures, dramatically reducing energy waste.

With many building managers now looking to find cost-effective ways to reduce energy use, the issue of retrofitting controls is an important one to consider. Developments in technology mean that this process is now much simpler than even five years ago. Open systems (such as BACnet) mean that it is much more straightforward to add a new control system, or to extend an existing one. However, it is important to plan ahead for this type of retrofitting project, and to ensure that the controls installers are aware of all the features of any existing controls systems.

Building controls in Part L 2010

Building controls are covered in *Part L* of the *Building Regulations*. The regulations state that "fixed building services shall have effective controls" and that control strategies should be organised "such that priority is given to the least carbon-intensive (energy source)."

Section 4 of *Part L 2010* makes the most extensive mention of how building controls should be used to minimise energy use in a building. Section 4:34 states that systems should be provided with appropriate controls to enable the achievement of reasonable standards of energy efficiency in use.

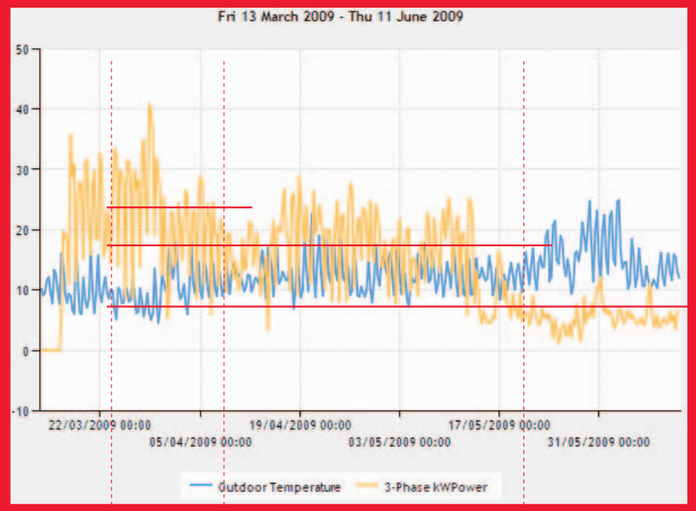
In normal circumstances, this section states that following features would be appropriate for heating, ventilation and air conditioning system controls:

1. The systems should be subdivided into separate control zones to correspond to each area of the building that has a significantly different solar exposure, or pattern or type of use.
2. Each separate control zone should be capable of independent timing and temperature control and, where appropriate, ventilation and air recirculation rate.
3. The provision of the service should respond to the requirements of the space it serves. If both heating and cooling are provided, they should be controlled so as not to operate simultaneously.
4. Central plant should operate only as and when the zone systems require it. The default condition should be off.

Building controls in action

SAVING ENERGY AND INCREASING COMFORT

One of the main challenges for building managers is to balance occupant comfort with energy efficiency. While it is possible to save energy and running costs simply by switching off heating and cooling systems, this would certainly lead to a high level of complaints and lower productivity among building occupiers.



Started monitoring energy with M2M

Optimised G50 with 5 Off per day

Activated MELCOTEL with 6 Offs per day, Night time Off, Night Set Back, Occupied Setpoint Reset and Outside Temperature Compensation

The users of a building have other influences on energy efficiency. Educating users about why they should not open windows while the air conditioning is on is an important part of achieving long-term energy efficiency. However, while this may be possible with occupants of an office building who are present every day and can learn new habits, it is not easy with short-term occupants such as hotel guests.

Mitsubishi Electric developed the Melcotel™ controller with this market very much in mind. Melcotel is designed to ensure that air conditioning is not working needlessly when rooms are empty, or if an occupant opens the window without switching off the heating or cooling. It also ensures that hotel residents can control the temperature in their rooms, but allows hotel management to predetermine temperature parameters – thereby ensuring that they are much more in control of energy consumption.

Details of a six-month trial were released in February 2010 and they demonstrate that Melcotel has delivered a 40% energy reduction for the air conditioning at Premier Inn's new city centre site in Leicester. The hotel was monitored before and after the installation of the controls.

The hotel's 135 bedrooms used an average of 17.20kWh of electricity per day. After the installation of Melcotel, this dropped to just 8kWh per day. The trials at the Premier Inn demonstrate the effectiveness of giving occupants a certain level of control, but enabling automatic overrides to greatly reduce energy waste.

At the start of the test, the air conditioning was set to turn off automatically at 1am, but still allowed guests to manually override the system. Mitsubishi Electric then introduced its G50 controller, to turn off the air conditioning automatically at five set times during the day (9am, 11am, 1pm, 4pm and 8pm) so that the system was more likely to be off while the room was unoccupied.

This led to some reduction in energy use. However, the Melcotel control goes further by responding more closely to occupant levels and temperature requirements. The controller resets the air conditioning to a predetermined setting and constantly monitoring the temperatures of any unoccupied rooms. The air conditioning in empty rooms will only come on to keep the temperature within a set range. This has the advantages of saving energy and also ensuring that the room reaches the desired temperature quicker when a guest enters the room.

Melcotel can also be linked to window sensors and will turn off the air conditioning system when windows are open to conserve energy further.

Further information

If you missed the CPD seminar on **Controls and Monitoring** you can call your Mitsubishi Electric Regional sales office to arrange an in-house presentation of this information.

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Mitsubishi Electric's commitment to the environment
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