ELECTRICAL POWER MEASUREMENT: THE IMPACT OF PART L2 OF THE BUILDING REGULATIONS

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Executive summary

Part L2 of the Building Regulations for England and Wales was introduced in October 2006 to help address energy efficiency requirements in non-domestic buildings. A prime focus for the regulations is providing building managers, landlords and tenants with detailed and accurate information about energy usage in their buildings to enable them to identify areas where energy is being wasted and where there are opportunities for reducing energy consumption.

The underlying philosophy of the regulations is ‘if you can’t measure it, you can’t manage it’. This means that the introduction of Part L2 has major implications for the way in which energy is measured in building electrical installations. In almost every case it is no longer acceptable to rely on the metering provided by the energy supply company as the sole means of measuring energy usage. Much more detailed information is now needed.

This white paper looks at the international and local concerns relating to climate change that have driven the implementation of Part L2 and at key measures that complement Part L2, before providing a concise overview of the regulations. It then looks at the latest CIBSE guidance on energy metering in non-domestic properties, before finally considering commercially available metering solutions that have been developed to address the challenge of meeting the requirements of Part L2.

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The Path to Part L2

In the last decades of the twentieth century, climate change and, in particular, the threat of global warming, were becoming of increasing concern and it was clear that internationally agreed measures were urgently needed to address these concerns. One of the earliest responses was the first World Climate Change Conference held in Geneva in 1979. This was essentially a scientific conference and its findings led to the establishment of the World Climate Programme and the World Climate Research Programme, as well as the Intergovernmental Panel on Climate Change.

A second Climate Change Conference was held in 1990, in part to review the activities and success of the bodies set up by the first conference. Scientists at the second conference issued a particularly strong statement highlighting the risks of climate change and this was, for the first time, accompanied by a Ministerial Declaration.

One of the most significant developments resulting from the second conference was the formulation of the United Nations Framework Convention on Climate Change (UNFCCC), an international treaty that encouraged countries to work cooperatively to consider what could be done to limit average global temperature increases and also to find ways of coping with those temperature increases that were already inevitable.

The UNFCCC came into force in 1994, but it was not long before most countries began to realise that the emission reduction provisions of the convention were inadequate, and further negotiations were launched to strengthen the worldwide response to climate change. These negotiations led to the adoption in 1997 of the Kyoto Protocol, which legally binds developed countries to emission reduction targets. The protocol, to which there are now 191 parties, did not, however, come into force until 15th February 2005.

The response of the UK government to the Kyoto Protocol was to launch a Climate Change Programme with the target of reducing carbon emissions, compared with the 1990 baseline, by 20% by the year 2020. This initial target has now been supplemented by the provisions of the Climate Change Act 2008, which require UK emissions of greenhouse gases to be reduced by an astonishing 80% by the year 2050. This provision includes not only carbon dioxide but also other greenhouse gases. Nevertheless, it is clear that limiting carbon dioxide emissions will play the central role in achieving this ambitious target.

The UK Climate Change Programme, which is the most ambitious in Europe, has led to the introduction of the Climate Change Levy (CCL), the setting up of the Enhanced Capital Allowance (ECA) scheme, and amendments to the Building Regulations. These are all government-led incentives that are designed to increase energy efficiency and to reduce carbon emissions.

Additionally, in 2004 the government published a new energy policy that reinforced the targets and was more specific about the details of the implementation plan. This policy is being led by the Carbon Trust working in conjunction with the Department for Environment, Food and Rural Affairs (DEFRA). The European Union has also been active in instituting measures to address climate change and has introduced the Energy Performance in Buildings Directive (2002/91/EC). This became EU law on 4th January 2003, and was transposed into law by each EU member state, including the UK, with effect from 4th January 2006.
Key Initiatives

The Enhanced Capital Allowance (ECA) scheme

The Enhanced Capital Allowance (ECA) scheme provides businesses with enhanced tax relief for investments in equipment that meets published energy saving criteria: businesses may deduct 100% of their qualifying expenditure against their taxable profits in the period of the investment. The Energy Technology Product List, which is managed by the Carbon Trust on behalf of the UK government, details products that meet the eligibility requirements of the ECA. Many of these products are useful for implementing energy savings in line with opportunities identified by data from metering systems installed to meet the requirements of Part L2 of the Building Regulations.

The CRC Energy Efficiency Scheme

The CRC Energy Efficiency Scheme was originally known as the Carbon Reduction Commitment, but its title has been changed to better reflect the scheme’s focus on enhancing energy efficiency. The scheme, which is central to the UK government’s strategy for improving energy efficiency and reducing emissions of carbon dioxide, applies initially to the largest users of energy. Participating organisations will have to monitor their emissions and buy allowances, which will at the outset be sold by the government, for each tonne of CO2 they emit.

An organisation that uses a lot of energy will, therefore, be spending a lot of money on allowances, while an organisation with lower energy requirements will spend less. There is, however, a carrot as well as a stick. Participating organisations will be ranked in an annual league table on the basis of how much they have reduced their emissions. The revenue raised by selling the allowances will be recycled back to the organisations and the amount they get depends on their position in the table, which means that there will be both winners and losers.

This scheme has been designed to raise awareness in large organisations, particularly at senior level, of the urgent need for climate change control measures, and to encourage changes in both behaviour and infrastructure.

The EU Energy Performance of Buildings Directive (EPBD)

The EU Energy Performance of Buildings Directive (EPBD) imposes minimum energy performance standards for all new buildings, and for buildings with a floor area of 1,000 m² or more that are undergoing major renovation. The directive also introduces a calculation methodology for determining the energy performance of buildings and requires an Energy Performance Certificate (EPC) to be provided when a building is being sold or leased.

Other requirements include the public display of an EPC, which must not be more than ten years old, in certain public buildings, regular inspection of air-conditioning systems and the use of qualified and/or accredited experts to provide the certificates and to carry out the inspections in an independent manner.

Energy Performance Certificates (EPCs)

Energy Performance Certificates (EPCs) must, in the UK, be provided by sellers and landlords for all buildings or parts of buildings when they are sold or rented. This requirement was phased in from 6th April 2008 when it applied to all buildings with a total floor area of 10,000 m² or more. This was extended to buildings with a total floor area of 2,500 m² from 1st July 2008, and to all commercial buildings on 1st
October 2008. For new buildings, those carrying out the construction are required to provide an EPC to the owner and a valid EPC is needed to obtain Building Regulations approval.

The EPC gives prospective buyers or tenants reliable information about the energy efficiency and carbon emissions of a building. Buildings with a poor energy rating are easily identified and, as a result, are becoming increasingly difficult to sell or let.

**Part L2 of the Building Regulations**

Driven by the Energy Performance of Buildings Directive, Part L2 of the Building Regulations for England and Wales was introduced in October 2006 to address energy efficiency requirements in non-domestic buildings. An essential element of Part L2 is the focus on understanding in detail the energy demands in buildings and the associated need to meter energy usage. This follows the underlying philosophy of 'if you can't measure it, you can't manage it'.

The declared purpose of introducing Part L2 is to allow building managers, landlords and tenants to understand where energy is used, where it is being wasted and where economies could be made. The aim is to create opportunities to reduce energy consumption by an amount that, it is anticipated, will be at least 5% per year and, in many cases, in excess of 10% per year.

Part L2 is divided into two sections. Part L2A covers new buildings and applies to all new non-domestic premises while Part L2B covers existing non-domestic buildings. Part L2B doesn’t automatically apply retrospectively, but it does come into effect when any "consequential improvement" – that is, an improvement that requires building regulations control approval – is carried out. In addition, when improvements are made, 10% of the expenditure involved must be devoted to energy saving and carbon reduction measures.

The central requirement of Part L2A and Part L2B is that businesses should be able to provide detailed information about where they are using energy. In general terms, installing sub-meters that enable at least 90% of the estimated annual consumption of each fuel to be accounted for is considered to be a reasonable provision. More specifically, the regulations state that:

"Reasonable provision of sub-metering would be to provide sub-metering such that the following consumptions can be directly metered or reliably estimated:

- Motor control centres for fans and pumps with a total load of 10 kW or more
- Boiler installations of 50 kW or more
- Chillers of 20 kW or more
- Electric humidifiers of 10 kW
- Final electrical distribution boards with a total load of 50 kW or more"

It is easy to see that these requirements cannot be met by the very basic metering provisions that have traditionally been adopted in building installations as these have, in most cases, been concerned only with monitoring total energy usage rather than collecting the information needed to analyse how and where that energy is being used.

**CIBSE General Information Leaflet 65**

To help with meeting the requirements of Part L2, the Chartered Institution of Building Services Engineers (CIBSE) has produced Information Leaflet 65, Metering energy use in new non-domestic buildings (GIL065). This leaflet, copies of which can be downloaded free of charge from
www.cibse.org/pdfs/GIL065.pdf, provides a clear guide for architects, designers and contractors not only on how to meet the Part L2 requirements, but also on how to develop effective metering strategies for buildings.

In particular, GIL065 explains the process for deciding how much metering to apply in specific circumstances. The examples given in the leaflet use manual methods, but many software programs are available to automate the processes involved. Alternatively, rather than carrying out this work themselves, architects and building designers may prefer to engage the services of a member of the Low Carbon Consultants Register.

The members of this register are a body of professionals who are competent to minimise energy use and carbon emissions from buildings in both design and operation. Buildings designed and operated by Low Carbon Consultants will meet the requirements of Part L (Conservation of Fuel and Power) of the Building Regulations, and Building Compliance Officers can be assured that compliance is being signed off by suitably qualified professionals. Members of the Register have undertaken examinations to demonstrate their competence and they are available for consulting on any issues relating to energy savings and carbon reduction.

Those who choose to work with GIL065 will find that it classifies energy measurement methods according to their reliability and accuracy. Direct metering, as would be expected, provides the highest levels of accuracy and reliability in the overall energy audit and is the preferred method wherever it is reasonably and economically practicable.

Acceptable alternatives include an hours-run meter, to measure the operating hours of a piece of equipment that has a constant known load, and indirect metering i.e. measuring the cold feed water consumption and temperature difference of a water heating system to calculate the energy used in heating the water. Another option may be to look at the difference between the data produced by two direct meters to estimate the energy consumed by a third end user. As a last resort, it may in some cases be reasonable to estimate the power used by small loads such as office equipment, as an alternative to installing extensive metering.

To ensure that the metering provisions suggested for a particular building do indeed meet the requirements of Part L2, GIL065 outlines an iterative process. This involves not only examining the proposed metering methods to decide whether they are simple and practical and whether they will give useful information at a reasonable cost, but also whether the metered energy accounts for at least 90% of the building’s incoming energy for each fuel. If any of these assessment criteria are not met, the process must be taken through another iteration.

GIL065 includes worksheets that aid this process – data is first entered into the worksheet, then metering is selected and the proposals are tested. As already indicated, the process is then iterated as required until a satisfactory outcome is obtained. At this point, the metering decisions are ready to be transferred to the design drawing for the building electrical installation, where a clear specification for each meter must be given, including details of any connections to the Building Energy Management Systems (BEMS) or the Automatic Metering and trending System (AMS).

**The Measuring Instruments Directive (MID)**

Anyone involved with specifying, designing and implementing energy metering solutions to meet the requirements of Part L2 will undoubtedly encounter references to the EU Measuring Instruments Directive (MID), which came into effect on 30th October 2006. The intention of this directive is to guarantee users a high level of safety and reliability in measuring instruments, and to create a single market for measuring
instruments across the EU. The directive defines operating requirements in relation to climatic conditions, mechanical environments and electromagnetic environments. Electrical meters are covered by category MI-003, Active Electrical Energy Meters.

As a consequence of the introduction of the MID directive, Ofgem (the Office of Gas and Electricity Markets) no longer approves or certifies new electricity meters for use with loads under 100 kW. Instead, notified bodies, designated and authorised by the EU member states as prescribed in the MID directive, must now certify meters for billing purposes. Meters approved by Ofgem before the MID directive was introduced can, however, continue to be manufactured and verified under the previous provisions (Gas and Electricity Acts) until 2016.

All new meter designs for gas and active electrical energy must conform to the requirements of the MID directive if they are to be used anywhere in the EU, including the UK, for 'trade purposes', which essentially means any kind of billing.

**Commercially Available Metering Solutions**

Once the energy metering provisions needed in a particular building to meet the requirements of Part L2 have been determined, providing the necessary metering is, in principle, straightforward. All that’s necessary is to fit kilowatt-hour (kWh) meters to measure the energy used by particular groups of loads. As always, however, the devil is in the detail. Even with new distribution systems, making extensive provision for metering can be costly and sometimes inconvenient. And when it comes to retrofitting existing distribution systems, the challenges are even greater, as the existing equipment is unlikely to have been designed with metering in mind.

Fortunately, leading electrical manufacturers such as Eaton have developed products specifically to simplify the provision of sub-metering in both new and existing installations. Eaton’s unique smart power and lighting distribution board, for example, provides independent metering of grouped power and lighting loads as standard. It is ideal for use in new installations in offices and other small to medium-sized commercial premises, where it is a much more convenient and cost-effective solution than installing independent sub-distribution boards for each type of load.

Eaton also offers metered Type A distribution boards for single-phase applications and metered Type B distribution boards for three-phase applications, which have meters pre-installed. As an alternative, the company supplies meter packs that are designed to fit alongside unmetered Type A and Type B boards to add metering provisions. The meter packs are a particularly attractive option for use with existing installations and, although they are primarily designed to complement Eaton Memshield 3 products, they can be conveniently used with many other types of distribution board.

There are many practical benefits to using pre-configured metered boards and meter packs. For example, they reduce installation time and wiring, the transducers are guaranteed to be matched to the meters, and they feature space-saving compact construction that is particularly desirable in retrofit applications where there is often very little room to install additional equipment. All Eaton distribution products with metering facilities use either MID compliant or Ofgem approved meters to guarantee the highest levels of accuracy and to ensure that the data provided by the meters can be used for billing.

Theoretically, meters that are read manually can be used to satisfy the requirements of Part L2 and, in the smallest buildings, this may be a practical solution. For buildings of even a modest size, however, the amount of data to be collected quickly becomes unwieldy and difficult to manage. The solution is to use meters that allow data to be collected automatically. The simplest of these have a pulse output that typically
pulses once for every kilowatt-hour of energy used. These pulses can be counted by a suitably arranged monitoring system.

A much more flexible approach, however, is to use meters with full communication facilities, which are typically based on the Modbus RS 485 protocol. Such meters can be interfaced easily and directly with building management systems (BMSs) and/or automatic metering and trending (AMT) systems, enabling building energy usage to be monitored and analysed easily and in detail, and the results readily incorporated into reports to confirm and document compliance with Part L2.

**Conclusion**

It would be easy to see the need to comply with the energy metering requirements of Part L2 of the Building Regulations as yet another government imposition on businesses, but that is a partial and somewhat misleading impression. Legislation may be the driver that is putting energy monitoring into buildings, but it’s the businesses occupying those buildings that will ultimately benefit most. Energy is already expensive, and the future trend in pricing is certain to be upward. Energy monitoring is a powerful tool for finding ways of reducing energy usage and its implementation will, therefore, ultimately bring big financial rewards that far outweigh its costs.

**About Eaton**

Eaton’s electrical business is a global leader with expertise in power distribution and circuit protection; backup power protection; control and automation; lighting and security; structural solutions and wiring devices; solutions for harsh and hazardous environments; and engineering services. Eaton is positioned through its global solutions to answer today’s most critical electrical power management challenges.

Eaton is a diversified power management company providing energy-efficient solutions that help our customers effectively manage electrical, hydraulic and mechanical power. With 2012 sales of $16.3 billion, Eaton is a global technology leader in electrical products, systems and services for power quality, distribution and control, power transmission, lighting and wiring products; hydraulics components, systems and services for industrial and mobile equipment; aerospace fuel, hydraulics and pneumatic systems for commercial and military use; and truck and automotive drivetrain and powertrain systems for performance, fuel economy and safety. Eaton acquired Cooper Industries plc in 2012. Eaton has approximately 103,000 employees and sells products to customers in more than 175 countries. For more information, visit [www.eaton.eu](http://www.eaton.eu).

**About the author**

David Pitt is product marketing manager responsible for power distribution products. He has particular interest in circuit breaker based protection devices and in enclosure systems. In the course of a long and diverse career in the electrical sector, David set up overseas manufacturing operations for MEM (now part of Eaton) in Malaysia and Singapore, and licensed third-party manufacturing in Australia and New Zealand.

David has an HND in Production Engineering. He is a Member of the IET and of the Chartered Institute of Marketing. Current objectives include working on the development of new circuit breaker based protection devices and enclosure systems within the Eaton UK country organisation. David also represents Eaton on BEAMA committees and working groups.