Electrical Safety First

The UK's electrical safety experts

Best Practice Guide 3 (Issue 2)

Connecting a **microgeneration system** to a **domestic** or similar **electrical installation**

(in parallel with the mains supply)

BestPracticeGuide

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Connecting a **microgeneration system** to a **domestic** or similar **electrical installation**

(in parallel with the mains supply)

The aims of this Guide are:

- to provide an overview of microgeneration intended to produce electrical energy, otherwise known as small-scale embedded generation (SSEG),
- to provide information on the legal and contractual issues relating specifically to the installation of microgenerators with electrical rating up to 16 A per phase (including the relationship of the consumer with the electricity supplier and the distribution network operator (DNO)), and
- to give guidance on the particular electrical issues, including electrical safety issues, that arise when installing or connecting a microgenerator.

The Guide takes into account the publication of Amendment 1 to BS 7671: 2008.

The Guide does not provide installation guidance specific to any particular types of microgeneration. BS 7671: 2008 Section 712 contains particular requirements for photovoltaic installations, as does DTI Publication URN 06/1972*, *Photovoltaics in Buildings, Guide to the installation of PV systems (2nd Edition)*, dated 2006. For any microgenerator installation, the instructions of the manufacturer or supplier should be followed.

The Guide does not provide installation guidance where it is intended to install more than one microgenerator. In such cases it is necessary to consider the possibility of interaction between the protection and control equipment of the microgenerators, and the specific advice of the manufacturers or suppliers of each of the microgenerators should be obtained and followed.

Where multiple microgeneration installations are to be installed in a close geographical region (such as in a housing development), it is also necessary to obtain the permission of the DNO in advance.

** URN 06/1972 is expected to be superseded in Autumn 2011 by a revised version, called Guide to the Installation of Photovoltaic Systems, containing material changes. Further information may be obtained from www.microgenerationcertification.org*

A ‘route map’ for getting a generation scheme connected to the distribution network can be found in the Energy Networks Association’s ‘*A Guide For Connecting Generation That Falls Under G83/1-1 Stage 2 To The Distribution Network*’, which may be downloaded from:
2010.energynetworks.org/storage/DGCG%20G83%20S2%20Nov%202010.pdf (It should be noted that Engineering Recommendation G83/1-1, referred to in the above ENA Guide, applies also to single microgeneration installations.)

The Guide does not cover Feed-in Tariffs in detail. On 1 April 2010 the Government launched Feed-in Tariffs (FITs), which are payments to microgenerators based on both what they generate, and what they export to the grid if they choose to do so. More information on FITs is available from www.energysavingtrust.org.uk

To be FIT-eligible, electricity-led microgenerator installations with a Declared Net Capacity of 50 kW or less must conform to the Microgeneration Certification Scheme (MCS). Other schemes may in future be approved as being equivalent.

An MCS installation is one in respect of which both the equipment being used and the installation company have been certificated by a UKAS-accredited Certification Body. The product will have been tested against performance, quality and safety standards before being certificated.

For an installation company to become certificated, a Certification Body will assess its technical competence, as well as checking that it has appropriate business processes (such as quality standards, complaints handling procedures etc). The installation company must also be party to an Office of Fair Trading-approved Consumer Code of Conduct.

More information on becoming an MCS installer, and on what equipment is currently approved under the scheme, is available from
www.microgenerationcertification.org

Introduction

The UK Government is committed to encourage the wider use of renewable energy generation, and to technologies such as combined heat and power (CHP) that offer improved efficiency compared to traditional bulk generation in large power stations.

This commitment reflects undertakings made with the UK’s partners in the European Union and internationally to reduce greenhouse gas emissions and reliance on fossil fuels.

Generation of electricity closer to the point of use avoids some of the losses that arise in the transmission and distribution of electricity to consumers. This currently amounts to up to 10% of units dispatched. Even for the most modern combined cycle gas generating stations with production efficiencies of 50-60%, the efficiency from the point of generation up to the point of use in a consumer’s installation is generally well below 50%.

Decentralised generation, if sufficiently widely adopted, could also improve the reliability and resilience of the electricity supply system, though this clearly depends on the types and relative amounts of generation that are installed. For example, photovoltaic systems do not generate at night, and wind power does not function at very low or very high wind speeds.

Photo courtesy of Sundog Energy Ltd

Photo courtesy of Sundog Energy Ltd

Over the past few years, considerable attention has been given to the development of microgenerators that are intended to be installed in domestic and similar premises. Such microgenerators are rated at up to 16 A per phase. At a nominal voltage to Earth (U_0) of 230 V, this corresponds to 3.68 kW on a single phase-supply or 11.04 kW on a three-phase supply.

A range of technologies has been emerging to take account of the rather different technical and operational challenges that the domestic environment presents compared to more traditional small generator designs.

Not least of these is the importance of providing simple, safe and reliable products at a price that is in proportion to the consumer's reduction in electricity purchase costs, so offering an attractive payback.

Types of generation

It is, of course, possible to install and operate a generator and installation completely independently of the normal mains supply and to run certain appliances entirely on this separate system. This Guide, however, considers only generators that are intended to work in parallel with an existing mains supply, as this represents the most practical approach for most consumers.

The assumption is that consumers generally will wish to continue to use electricity as and when required at the throw of a switch, without needing to be aware as to whether the generator is working or not.

Currently, the options can be divided into two broad classes from the point of view of connection into an existing installation:

- Renewable sources of electricity, powered by wind, light or hydro-power, or fuel cells. Many of these generate at d.c. and are connected to the mains through a d.c. to a.c. inverter

Photo courtesy of Evoko Energy Ltd

Photo courtesy of British Gas

- Gas, oil and biomass fired micro-cogeneration (combined heat and power (CHP)) systems. The primary function of these systems is to provide for heating and hot water needs, in place of a traditional boiler or water heater. However, they include a small generator that provides electricity, powered by some of the heat energy produced for the water heating process. This Guide does not give guidance on the heat production aspects of microgenerators.

Renewable sources of heat using solar thermal panels, ground or air source heat pumps or biomass boilers that do not generate electricity are not covered by this Guide.

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As previously mentioned, microgenerators are generally characterised as having an output of no more than 16 A per phase. In the case of micro-cogeneration (CHP) systems, because the electricity generation is ancillary to the heating of water and so represents only a part of the output of the system, the electrical output is typically in the range of 4 to 6 A.

Photo courtesy of Powergen

Legal and related issues

When at work, even in domestic premises, an electrical installer is subject to relevant Health and Safety legislation, including the Electricity at Work Regulations.

Installers of microgenerators will need to be aware of the requirements of the relevant Building Regulations. In domestic premises in England and Wales, the installation of a microgenerator is notifiable under Part P. In Scotland, a Building Warrant may be required (further information is available at www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards).

Some forms of microgenerator may be subject to planning law and to the non-electrical aspects of the Building Regulations, in particular structural considerations.

Although an electrical installer might not be involved in such issues on behalf of his client, they may impact on an unwary electrical installer in carrying out his work.

Therefore, before commencing work, it is advisable to consider the issues covered below.

(A) The installation of renewable energy sources often requires Planning permission. Therefore whether the proposed work is subject to these requirements or is considered 'permitted development' should be determined before the work commences. This is undertaken by contacting the local Planning Authority, who, should Planning permission be required, will indicate what information they require to be provided with the Planning application.

In England and Wales, the relevant Building Regulations will normally apply to work in the domestic situation. Depending on the nature of this work, these regulations may cover electrical installations, various structural implications (such as the ability of the existing building to carry the additional load or forces produced at the fixing points) and damp penetration issues, as appropriate. Compliance is achieved either through the appropriate 'Competent Person Scheme' or by applying to a building control body, such as the Local Authority Building Control. Further information can be obtained from the Planning Portal (www.planningportal.gov.uk).

- Before fixing microgeneration equipment to a building, consideration should be given by the installer to the structural condition of the building. This may involve a structural survey.
- In Scotland, a Building Warrant may be required.
- Hydro turbines may require planning consent and will also require a water abstraction licence.

Photo courtesy of Energy Saving Trust

(B) The Electricity Safety, Quality and Continuity Regulations 2002 contain, in regulation 22, requirements for the installation and operation of generators in parallel with the distributor's network. These generally prohibit the connection of a generator without prior consent of the distributor (typically the relevant regional distribution network operator (DNO)), and contain requirements concerning design and operation that are likely to prevent parallel operation of generators in domestic premises.

However, an exemption is given in regulation 22(2) for the installation of generation rated up to a total of 16 A per phase, provided:

- it has protection that will disconnect from the mains supply automatically in the event of the loss of the mains supply
- the installation complies with the edition of BS 7671 (Requirements for Electrical Installations) current at the time of installation, and
- the installer notifies the DNO before or at the time of commissioning the microgenerator.

Details of the general requirements for connecting an SSEG and the characteristics for the protection scheme necessary to provide automatic disconnection following loss of mains or variation of voltage or frequency from the declared values are contained in the Energy Networks Association's Engineering Recommendation G83 (version G83/1-1†) and in BS EN 50438.

The installer should refer to the manufacturer's documentation to confirm that the microgenerator complies with the relevant requirements of G83 or BS EN 50438.

Details of the requirements for notifying the DNO before the time of commissioning the microgenerator are contained in G83 and in BS EN 50438.

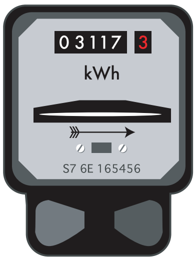
In addition to notifying the DNO before or at the time of commissioning a microgenerator, the installer must provide the DNO with an Installation Commissioning Confirmation Form, a copy of the circuit diagram showing the circuit wiring, and the manufacturer's Verification Test Report, all within 30 days of the microgenerator being commissioned (clause 5.1.1 of G83/1-1† and clause 7.3.1 of BS EN 50438: 2007 refer).

Where generation exceeding 16 A output in total is to be provided in a single installation, or where multiple microgeneration installations are to be installed in a close geographical region (such as in a housing development), it is necessary to obtain the permission of the DNO in advance.

† G83/1-1 is expected to be superseded by a revised version (G83/2), containing material changes, during late 2011 or early 2012.

Contract with the electricity supplier

Generators rated at up to 50 MW are exempted from licensing under the Utilities Act, so microgenerators covered by this Guide are exempt.



Energy users will have a contract with an electricity supplier for the purchase of electricity. Invariably the supply is provided through a meter. The meter will be either a prepayment meter (the customer pays in advance with cash or tokens) or a credit meter (the meter is read and the customer is billed retrospectively). In either case, the contract is for the supply of electricity to the premises.

If at any time the consumer's microgenerator generates more electrical power than is being used in the premises, the surplus will go into the electricity network.

The exporting of energy from the premises in this way will only be covered by the consumer's contract with the electricity supplier if a specific written agreement to that effect has been entered into by the consumer with the supplier, as will be the case if the customer applies to that supplier for the payment of Feed-in Tariffs.

Where this is the case, the electricity supplier may arrange for an export meter to be installed at the premises. However, where the installed capacity of the generator is less than 30 kW, the supplier may defer doing this until smart meters are rolled out.

In the absence of an export meter, the amount of energy exported will be deemed to be a percentage of the energy generated by the microgenerator. The energy generated will be ascertained from the generation meter, which forms part of the microgeneration installation. The fixed display unit of the generation meter must be installed in an accessible location.

The existing meter at the premises (the import meter) may not require replacement until smart meters are rolled out. However, the electricity supplier is likely to arrange for this meter to be replaced if it does not have a 'backstop' to prevent the energy register from running backwards during export, which would lead to double counting of exported energy.

In the unlikely circumstances that an agreement and the associated metering equipment are not in place for the export of electrical energy from the premises, the reverse flow of energy can have an impact on the supplier's electricity meter at the premises in one of the following ways.

- Where the meter is fitted with a backstop to prevent the energy register from running backwards, the consumer will receive no compensation for exported energy.
- Some meters with a backstop have a flag that is tripped by reverse power flow, which could result in the consumer being accused of stealing energy.
- A prepayment meter may have an internal contactor that cuts off the mains supply if the energy flow is reversed.

Some older meters do not have a backstop and the register will run backwards while energy is being exported, effectively 'crediting' the consumer with energy at the rate at which they normally pay for the electricity. This could be treated by the electricity supplier as a form of theft.

Electrical installation

Safety issues

Installing a microgenerator brings particular additional electrical safety concerns, which include the following.

- Persons must be warned that the electrical installation includes a microgenerator so that precautions can be taken to avoid the risk of electric shock. Both the mains supply and the microgenerator must be securely isolated before electrical work is performed on any part of the installation.
- Adequate labelling must be provided to warn that the installation includes another source of energy. Suitable labelling is suggested in G83 and, for photovoltaic systems, in DTI Publication URN 06/1972*, *Photovoltaics in Buildings, Guide to the installation of PV systems (2nd Edition)*, dated 2006.
- It must be remembered that wind turbines are likely to produce an output whenever they are turning and PV cells will produce an output whenever they are exposed to light. Additional precautions, such as restraining the turbine from turning or adopting the means given in DTI Publication URN 06/1972* to improve safety on the d.c. side of a PV system, will be necessary when working on those parts of the circuit close to the source of energy and upstream of the means of isolation.

In some respects, microgenerators can be considered to be similar to any current-using equipment. For example:

- live parts will invariably be insulated or have an earthed or insulating enclosure
- the metallic enclosure of a Class I microgenerator will need to be connected to the circuit protective conductor.

However, there are other aspects that require care to ensure that the existing level of electrical safety is maintained for the users following the installation of a microgenerator.

As mentioned previously, the exemption to the requirement for prior consent of the DNO, contained in Regulation 22(2) of the Electricity Safety, Quality and Continuity Regulations 2002, requires compliance with BS 7671 (DTI Publication reference - URN 02/1544, which gives guidance on the Electricity Safety, Quality and Continuity Regulations 2002, refers). Prior to commencing the installation of a microgenerator, the installer must confirm such compliance, for example, by examining a recent Electrical Installation Condition Report (Periodic Inspection Report) for the existing installation (if available), or by carrying out a Periodic Inspection.

In order for a microgenerator to be placed on the market, the manufacturer or supplier of the microgenerator is required to declare compliance with the Electrical Equipment (Safety) Regulations and the Electromagnetic Compatibility Regulations. The components of the microgenerator will be CE marked to confirm this. Also, for an MCS compliant installation, it is a requirement that the equipment being used has been certificated by a UKAS-accredited Certification Body where applicable (such as for the modules of a PV system). Inverters do not require such certification.

Compliance with these requirements should ensure that the microgenerator will be satisfactory in an installation in terms of the power factor, generation of harmonics, and voltage disturbances arising from starting current and synchronisation.

Any synchronising system should be automatic and of a type that considers frequency, phase and voltage magnitude. The microgenerator should also have documentation confirming, amongst other things, the acceptability of the means of protection against operation in the event of loss of the mains supply, as required by G83 or BS EN 50438.

** URN 06/1972 is expected to be superseded in Autumn 2011 by a revised version, called Guide to the Installation of Photovoltaic Systems, containing material changes. Further information may be obtained from www.microgenerationcertification.org*

In designing a connection for a microgenerator, the electrical installer has to consider all the issues that would need to be covered for a conventional final circuit, including:

- the maximum demand (and the generator output)
- the type of earthing arrangement
- the nature of the supply
- external influences
- compatibility, maintainability and accessibility
- protection against electric shock
- protection against thermal effects
- protection against overcurrent
- isolation and switching
- equipment selection and installation issues.

The electrical installer will recognise that some of these issues can be changed by the connection of a microgenerator to an existing installation.

It is unlikely with the size of microgenerators covered by this Guide that the prospective fault current would change sufficiently to exceed the fault rating of existing protective devices, but this should be confirmed.

Photo courtesy of GTEC Training Limited

Photo courtesy of J Bradley

From the specific perspective of a microgenerator, except for a PV system (see below), there are two connection options:

- connection into a separate dedicated circuit
- connection into an existing final circuit.

For a solar photovoltaic (PV) power supply system (including a PV microgeneration installation), the second option – connection into an existing final circuit – is not permitted by Regulation 712.411.3.2.1.1 of BS 7671 or by clause 4.2 of Microgeneration Installation Standard: MIS 3002, and the generator must therefore be connected into a separate dedicated circuit.

Examples of the two options are shown diagrammatically in Fig 1.

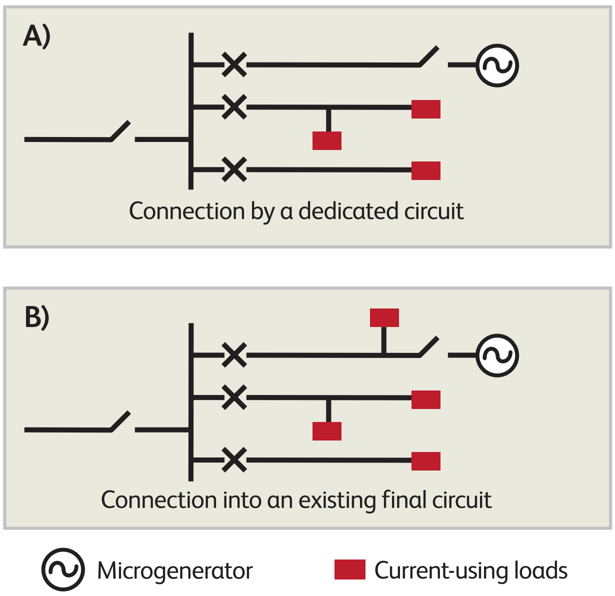


Fig 1 *– Examples of the two connection options for a microgenerator*

Given the perceived constraint of financial viability on the development of the market for microgenerators, the second of these options has been considered by some product developers to offer a simple solution with minimal disruption to the consumer's property.

From the perspective of the electrical safety of the installation, however, this option can create design limitations for the installer of the microgenerator, and limitations for the user of the installation.

Connection into a dedicated circuit is preferred.

This option is technically simpler and creates least impact on existing use and hence on the user of the installation. The cost implication may not be significant when compared to the cost of the generator itself, and in some cases it may be less expensive in view of the need to meet the technical requirements detailed below for connecting into an existing final circuit.

Whichever of the two options is chosen, it is imperative that the safety of the electrical installation is not impaired by the installation of the microgenerator.

The essential criteria that must be met are given below for both options. In either case the following requirements must be met:

(i) The winding of an a.c. microgenerator must not be earthed (clause 6.4 of G83/1-1† and clause 4.1.3 of BS EN 50438: 2007 refer). The reason for this precaution is to avoid damage to the generator during faults on the distribution network and to ensure correct operation of protective devices.

Note. *A d.c. source or d.c. microgenerator could be earthed provided the inverter separates the a.c. and d.c. sides by at least the equivalent of a transformer providing simple separation. Such earthing, which may be necessary for functional purposes in some cases, requires special consideration and is beyond the scope of this Guide.*

† G83/1-1 is expected to be superseded by a revised version (G83/2), containing material changes, during late 2011 or early 2012.

(ii) Means must be provided to automatically disconnect the microgenerator from the mains supply in the event of loss of that supply or deviation of the voltage or frequency at the supply terminals from the declared values. If the microgeneration installation includes a static inverter, the means must be on the load side of the inverter. (Regulation 551.7.4 of BS 7671 refers.)

Note. *The required protection settings are given in G83 and in Annex A of BS EN 50438.*

(iii) Means must also be provided to prevent the connection of the microgenerator to the mains supply in the event of loss of that supply or deviation of the voltage or frequency at the supply terminals from the declared values (Regulation 551.7.5 of BS 7671 refers).

Note. The requirements are given in G83 and in BS EN 50438. Amongst other things, it is required that feeding power to the distribution network will only commence after the voltage and frequency on the distribution network have been within the limits of the interface protection settings for a minimum of 3 minutes for mechanical a.c. generation or 20 s for inverter based systems.

(iv) Where a microgenerator having a d.c. source does not incorporate the equivalent of a transformer providing at least simple separation between the d.c. and a.c. sides, an RCD installed for fault protection by automatic disconnection of supply or for additional protection ($I_{\Delta n} \leq 30$ mA) must be of a type that will operate as intended in the presence of d.c. components in the residual current. (This does not apply where it has been established – such as from a specific written statement given by the inverter manufacturer – that the inverter provides galvanic isolation between the d.c. and a.c. sides that prevents it from feeding d.c. current into the electrical installation.)

Note. *A Type AC RCD will not fulfil the above requirement. Depending on the level and form of d.c. components, an RCD (where required) will need to be of Type A to BS EN 61008 or BS EN 61009, Type B to IEC 62423, or Type F to IEC 62423. However, in the case of a PV power supply installation, Regulation 712.411.3.2.1.2 of BS 7671 stipulates that the RCD (where required) shall be of Type B.*

(v) Where a microgenerator is installed in a special installation or location covered by a specific section of Part 7 of BS 7671, the requirements applicable to that special installation or location must also be applied as relevant to the microgenerator. For example, this might place limitations on the positioning of the microgenerator, involve additional protection with an RCD or supplementary bonding, or the selection of a microgenerator with a specified IP rating.

The specific additional requirements for each of the two connection options are given below.

Connection of a microgenerator to a dedicated circuit (Fig 1(a) refers)

(vi) The basic design parameters for the circuit are:

- $I_b \geq I_g$, where I_b is the design current and I_g is the rated output current of the microgenerator (Regulation 523.1 of BS 7671 refers)
- $I_n \geq I_b$, where I_n is the rated current of the overload protective device (Regulation 433.1.1(i) of BS 7671 refers)
- disconnection of the circuit in the event of an earth fault on the circuit within 5 s for TN systems and 1 s for TT systems (Regulations 411.3.2.3 and 411.3.2.4 respectively of BS 7671 refer).

(vii) The circuit must connect to the supply side of the overcurrent protective device of each final circuit of the installation (Regulation 551.7.2, second line, refers). This can be achieved by connecting the circuit to a dedicated outgoing overcurrent protective device in the consumer unit.

(viii) Where a microgenerator is connected on the same side of an RCD as final circuits protected by that RCD, the RCD must disconnect the line and neutral conductors (Regulation 551.4.2 refers). For example, this applies to an RCD controlling a section of a consumer unit to which the dedicated circuit is connected via an outgoing way.

Note. *The reason for the above requirement is that if the RCD does not disconnect the neutral, protection no longer depends solely on the operation of the RCD, but also on the shut down characteristics of the microgenerator, due to the existence of a current path similar to that shown in Fig 2. (It might be thought that the RCD need not disconnect the neutral if the dedicated circuit is connected to the consumer unit via an RCD, such as is mentioned in (ix). However, that is not the case, as that RCD would be unable to operate in response to current flowing to earth on its mains supply side, because (as mentioned in (i)) the winding of the microgenerator is not earthed.)*

(ix) Where the circuit requires RCD protection, such as may be the case where the circuit cable is concealed in a wall or partition (Regulations 522.6.102 and 522.6.103 refer), the RCD must be located at the consumer unit end of the cable (generally by using an RCBO as the dedicated protective device for the circuit).

Note. *There is no need to locate an RCD at the microgenerator end of the circuit too, provided the winding of the microgenerator is not earthed (as should be the case – see (i)), as that RCD would be unable to detect a current flowing to earth supplied by the microgenerator.*

(x) The microgenerator must be provided with means of isolation and of switching off for mechanical maintenance. (Regulation Groups 537.2 and 537.3, respectively, of BS 7671 refer. For PV systems, see also Regulation Group 712.522.8.3.)

Note. *See also 'Labelling and isolation', later in this Guide.*

Connection of a microgenerator to an existing final circuit (Fig 1(b) refers). (Not permitted for a PV power supply system – see 712.411.3.2.1.1)

(xi) The basic design parameters for the circuit are as follows.

a) $I_z \geq I_n + I_g$, where I_z is the current-carrying capacity of the conductors of the final circuit, I_n is the rated current of the overload protective device and I_g is the rated output current of the microgenerator (Regulation 551.7.2(i) of BS 7671 refers). This may require the protective device to be replaced with one having a lower rated current.

b) The microgenerator must not be connected to the final circuit by means of a plug and socket (Regulation 551.7.2(ii) refers).

c) An RCD providing additional protection for the final circuit (where required) must disconnect all line and neutral conductors (Regulation 551.7.2(iii) refers).

d) The line and neutral conductors of the final circuit or of the microgenerator must not be connected to Earth (Regulation 551.7.2(iv) refers). For example, as already stated in (i), the winding of the microgenerator must not be earthed.

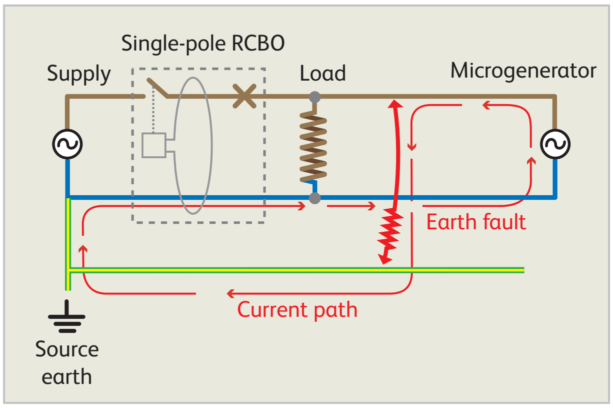
e) The protective device providing fault protection for the final circuit must disconnect the line and neutral conductors. The only exception to this requirement is where it has been verified that in the event of an earth fault on the circuit, the operation of the protective device and the reduction of the voltage of the microgenerator to 50 V or less will both occur within the disconnection time required by Regulation 411.3.2 for the final circuit. (Regulation 551.7.2(v) refers.)

f) The microgenerator must be provided with means of switching off for mechanical maintenance and of isolation from the remainder of the final circuit (Regulation Groups 537.2 and 537.3, respectively, refer).

Note. *See also 'Labelling and isolation', later in this Guide.*

The reason for the requirement in (xi)e) is that, if the protective device does not disconnect the neutral, the effectiveness of the protection no longer depends solely on the operation of the protective device, but also on the shut down characteristics of the microgenerator. Fig 2 shows, as an example, an earth fault downstream of an RCBO with unswitched neutral. The earth fault causes operation of the RCBO, but the microgenerator can still supply current through the earth fault via the path shown in the diagram for a period until its own internal protection against loss of mains causes the microgenerator to shut down.

Fig 2 – Example illustrating the reason for the requirement in (xi)e)



It should be noted that if the RCD element in the RCBO has been provided for additional protection, this arrangement is not permitted and the RCBO would need to switch both the line and neutral conductors; see (xi)c).

Isolation and labelling

A microgenerator is a source of supply to the electrical installation. A main linked switch or linked circuit-breaker for this source must therefore be provided in a readily accessible position as near as practicable to the origin of the installation, such as adjacent to the consumer unit, as a means of switching off the supply on load and as a means of isolation (Regulations 132.15.1, 537.1.4 and 551.2.4 refer). The switch or circuit-breaker must disconnect the line and neutral conductors (Regulation 537.2.1.1 refers).

Means must also be provided to isolate the microgenerator from the public mains supply, as required by Regulation 551.7.6. This must be located at an accessible position within the installation, as required by clause 5.3 of G83/1-1†. Clause 4.2.1.3 of BS EN 50438: 2007 states that 'Where this means of isolation is not accessible for the DNO at all times it is acceptable to provide two means of automatic disconnection, with a single control. At least one of the means of disconnection must be afforded by the separation of mechanical contacts.'

The same means of isolation could be used for the purposes of both the previous two paragraphs, if it meets all the requirements referred to in those paragraphs.

If the microgenerator is not in the same room as the main linked switch or linked circuit-breaker (as may be the case with the inverter of a PV system), a local isolator should also be installed adjacent to the microgenerator (Regulation 537.2.1.1 refers).

In all instances, the means of isolation, which must be manual, must be capable of being secured in the 'off' isolating position (Regulation 537.2.1.2 refers).

Where a static inverter forms part of the microgenerator installation, a means of isolation must be installed on both sides of the inverter. However, this requirement does not apply on the power source side of an inverter that is integrated in the same enclosure as the power source. (Regulation 551.4.3.3.3 refers).

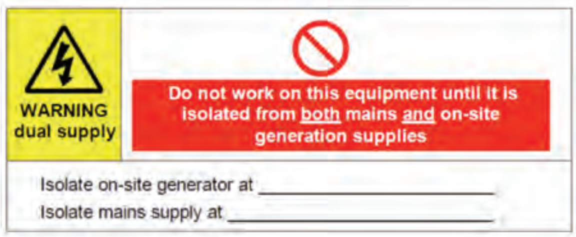
Isolation and switching devices in any d.c. circuits, such as on the d.c. side of a PV installation, must be of types suitable for d.c use. Switchgear intended for a.c. circuits is often not suitable for d.c. or may need to be derated for such use. The manufacturer's specific advice in this respect should be obtained and followed.

To comply with the labelling requirements of Regulation 514.15.1 relating to alternative or additional sources of supply, and those of clause 6.2 of G83/1-1† and clause 6.4 of BS EN 50438: 2007, warning labels must be provided as a minimum at:

- the DNO's fused cutout
- the DNO's meter position
- the consumer unit(s)
- the output terminals of the microgenerator
- the points of isolation for the mains supply and the microgenerator supply.

In the case of a renewable source, such as PV cells or a wind turbine, a notice must be placed at the microgenerator isolator to warn that the conductors on the microgenerator side may remain live when the isolator is open.

The Health and Safety (Safety Signs and Signals) Regulations 1996 stipulate that the labels should display the prescribed triangular shape and font size using black on yellow colouring. A typical label is shown below.



The above label is reproduced from Figure 1 of G83/1-1

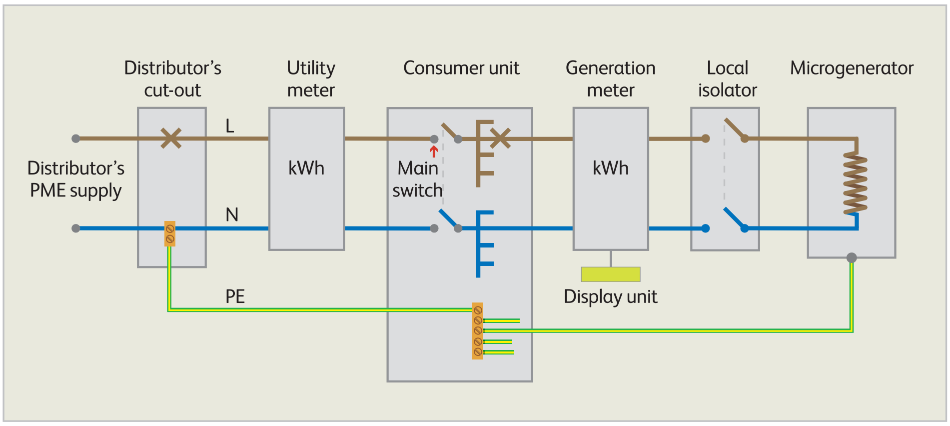
In addition, G83 requires up-to-date information to be displayed at the point of connection with a DNO's network as follows.

† G83/1-1 is expected to be superseded by a revised version (G83/2), containing material changes, during late 2011 or early 2012.

A circuit diagram showing the relationship between the microgenerator and the DNO's fused cut-out. This diagram is also required to show by whom the generator is owned and maintained.

A summary of the separate settings of the protection incorporated within the equipment. The figure below is an example of the type of circuit diagram that needs to be displayed. This diagram is for illustrative purposes and not intended to be fully descriptive.

The installer is required to advise the customer that it is the customer's responsibility to ensure that this safety information is kept up to date.



The installation operating instructions must contain the manufacturer's contact details, such as name, telephone number and web address.

ANNEX 1

Glossary/Definitions:

Combined heat and power (CHP)
Process that generates heat some of which provides the motive power to a microgenerator that is part of the heat generating device

Distribution network operator (DNO)
Owner or operator of low voltage electrical lines and equipment that are used to distribute electricity to consumers

Electricity supplier
A person who supplies electricity to a consumer from a DNO's network

Export meter
A meter, complying with the appropriate meter legislation, which measures the amount of electricity being exported to the electricity network

Generation meter
A meter which the energy user is responsible for, complying with the appropriate meter legislation, and which measures the quantity of electricity generated by the energy user's generation unit

Microgenerator
A device rated at up to 16 A per phase designed for the small-scale production of heat and/or electricity from a low carbon source (based on the definition in section 82 of the Energy Act 2004)

Network
Low voltage electrical lines and equipment owned or operated by a DNO that are used to distribute electricity to consumers

RCBO
An electromechanical protective device intended to provide overcurrent protection and residual current protection

SSEG
(Small Scale Embedded Generation/Generator) microgenerator

Type AC RCD
An RCD intended to operate for residual sinusoidal alternating currents, whether suddenly applied or slowly rising.

Type A RCD
An RCD intended to operate for the following forms of residual current, whether suddenly applied or slowly rising:

- residual sinusoidal alternating currents
- residual pulsating direct currents
- residual pulsating direct currents superimposed on a smooth direct current of 6 mA.

Type B RCD
An RCD intended to operate for the following forms of residual current, whether suddenly applied or slowly rising:

- residual sinusoidal alternating currents up to 1000 Hz
- residual alternating currents superimposed on a smooth direct current of 0.4 times the rated residual operating current
- residual pulsating direct currents superimposed on a smooth direct current of 0.4 times the rated residual operating current
- residual direct currents which may result from rectifying circuits.

Type F RCD
An RCD intended for installations where frequency inverters are supplied between line and neutral or line and earthed middle conductor, and able to provide protection in the event of alternating residual sinusoidal at the rated frequency, pulsating direct residual currents and composite residual currents that may occur.

ANNEX 2

British Standards and other standards referred to:

British Standards

BS 7671

Requirements for electrical installations. IET Wiring Regulations. Seventeenth edition

BS EN 50438

Requirements for the connection of micro-generators in parallel with public low-voltage distribution networks

BS EN 61008

Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs). General rules

BS EN 61009

Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs). General rules

Other standards

IEC 62423

Type F and type B residual current operated circuit-breakers with and without integral overcurrent protection for household and similar uses

The latest versions of all the **BestPractice**Guides
are available to download from www.electricalsafetyfirst.org.uk

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Electrical Safety First is the UK charity dedicated to reducing deaths and injuries caused by electrical accidents. Our aim is to ensure everyone in the UK can use electricity safely

Electrical Safety First
The UK's electrical safety experts