PV Installation

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1. Recommendations

- Avoid touching the +V and -V terminals to prevent damage.
- Minimize the distance between the panels and the charge controller or inverter to reduce losses caused by wiring.
- Leave space between panels to mitigate wind effects.
- Ensure there are no obstacles or shadows blocking the solar cells.
- Proper earthing should be done for the enclosure and mounting components of the PV panels.

2. Materials

- A wire is typically made of copper or aluminium and consists of a single conductor.
- A cable is usually made of copper or aluminium and consists of multiple wires bundled together with insulating material.

Solar Cables:

- Solar cables are specifically designed for use in photovoltaic power systems, featuring UV radiation resistance and the ability to operate in a wide range of ambient temperatures (from -40°C to 100°C).
- These cables are suitable for permanent outdoor installations, enduring variable climate conditions.
- They have an expected lifespan of 30 to 40 years.

3. Colour Code

There are various regulations to consider when working with electrical installations. It is important to review the 18th Edition of the Electrical Installation Regulations for a deeper understanding and to ensure compliance with the latest safety standards.

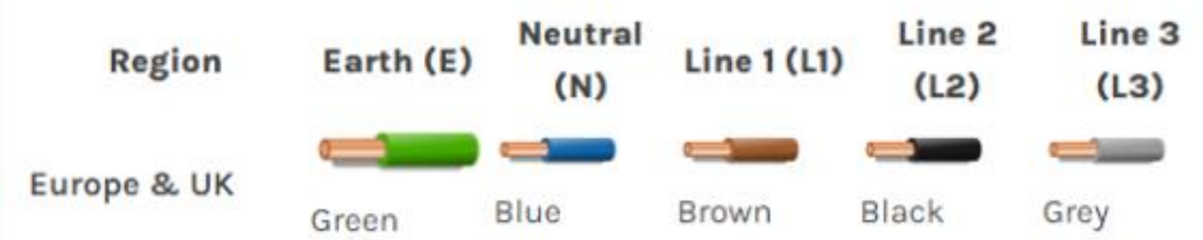

Figure 1: Standard Colour Code in the UK

4. PV Maximum Voltage

The maximum system voltage for residential solar panel installations is typically 1000V DC. However, many residential systems are designed to operate at lower voltages, such as 600V DC or 800V DC, to ensure safety and meet local regulations.

In cold, sunny conditions, the array voltage will increase, so it’s crucial to account for this when designing your system to ensure the voltage stays below the maximum limit. Cold temperatures cause solar panel voltage to rise, which can potentially exceed system limits if not considered during the design phase. Proper calculations must be made to avoid exceeding the maximum system voltage, ensuring safe and efficient operation.

Example 1:

If a module has a temperature coefficient (*TkV*) of -0.1V per °C, this means that for each degree Celsius below 25°C, the module's voltage will increase by 0.1V, and for temperatures above 25°C, it will decrease by 0.1V.

For a module with an output voltage of 56.6V and a temperature coefficient for voltage of -0.36% per °C, the voltage will increase by 0.204V for each degree below 25°C.

$$V = 56.6 * \frac{0.36}{100} = 0.204V$$

Equation 1: Voltage drop per °C

Example 2:

Considering the previously calculated value for the voltage drop per degree Celsius and the location's extreme temperature of -23°C, and a maximum voltage of 600V. We need to determine the change in temperature.

$$\Delta T = T_1 - T_2$$

$$\Delta T = 25 - (-23) = 48℃$$

Equation 2: Change in temperature.

Given a temperature difference of 48°C from the initial measurement taken at 25°C, the voltage will increase by 9.8V.

$$V = 48 * 0.204 = 9.8V$$

Equation 3: Voltage increment.

With the voltage increment at -23°C, the maximum expected voltage is 66.4V.

$$V = 56.6 + 9.8 = 66.4V$$

Equation 4: Final voltage at -23°C

If we have an array of 10 of these modules in series, the resulting maximum system voltage would be 664V. This exceeds the maximum voltage requirement, so it’s important to reduce the number of panels to meet the specified requirements.

$$V = 66.4 * 10 = 664V$$

Equation 5: Total voltage for the solar panel's array.