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Federal Office of the Environment, Transport, Energy and Communications
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Electromagnetic Compatibility (EMC)

Interference with radio communications services caused by photovoltaic systems

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- Photovoltaic systems can interfere with radio communications services, especially if they are equipped with optimisers. These act as a source of interference.
- Systems must therefore be installed in accordance with the recognised engineering practices and meet the requirements of the Ordinance on Electromagnetic Compatibility (OEMC).
- If OFCOM is notified of a fault, it carries out measurements. If the requirements are not met, the owner of the photovoltaic system must arrange for it to be modified or, if necessary, switch it off.
- Certain manufacturers of optimisers are still taking advantage of the lack of standardisation in this field, and so save on the filters necessary to provide a minimum level of protection for the radio spectrum.

1 Introduction

This document provides information on the undesirable effects of certain photovoltaic systems on the electromagnetic spectrum, which can lead to interference with radio communications services. It is intended for all current and future owners of photovoltaic systems and the businesses that install these systems. It explains what a fixed installation is, summarises the different types of photovoltaic installations and provides specific information on the optimisers that form part of certain photovoltaic installations and whose installation can potentially interfere with radio communications services. It also describes what action OFCOM takes when a photovoltaic installation causes interference and how it carries out inspections. Finally, this document also lists the legislation relating to the electromagnetic compatibility of photovoltaic systems.

2 Fixed systems

The following information applies to photovoltaic systems (PV systems) which are regarded as fixed systems. The Ordinance on Electromagnetic Compatibility (OEMC, Art. 2 let. c [1]) defines this term as follows:
A particular combination of apparatus and if applicable other appliances that are connected or installed together and which are intended to be used permanently at a predefined location.

In order to prevent frequency interference, PV systems must meet various requirements in accordance with the OEMC:

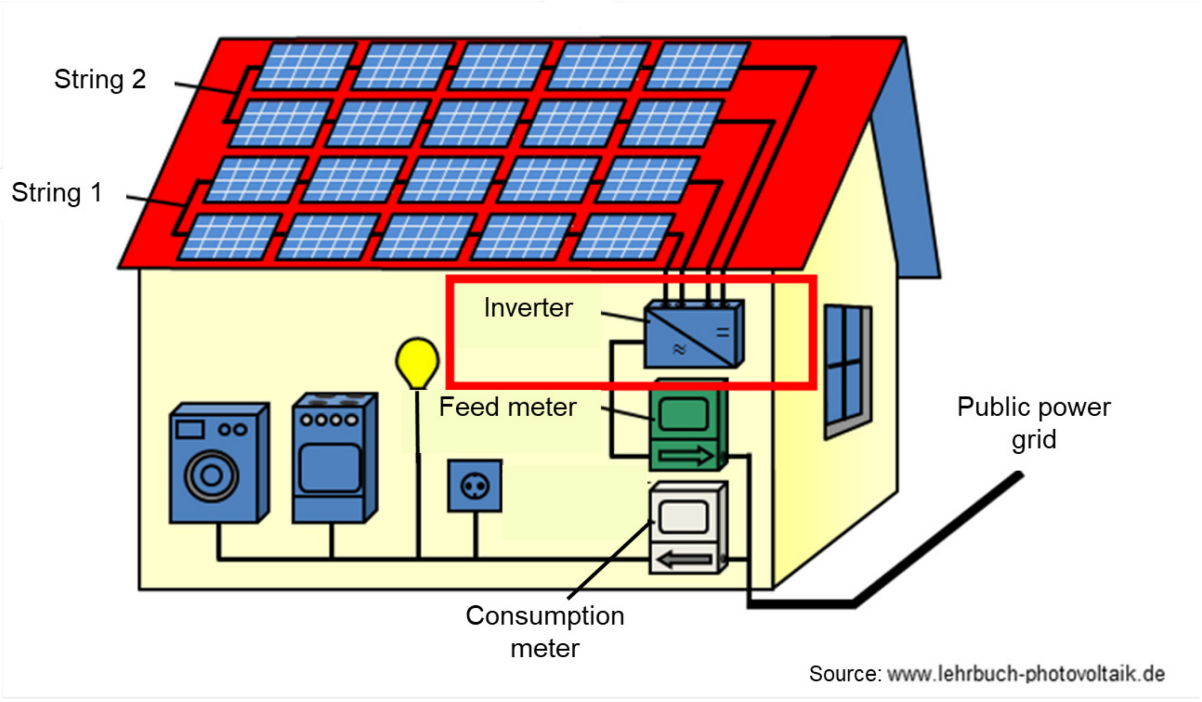
- The system must fulfil the basic requirements. This means that it may not cause any unacceptable interference, nor itself be interfered with.
- The PV system must be built in accordance with the recognised engineering practices. Its components must be installed in accordance with the manufacturer's instructions. The installation must be documented by the installer and this documentation must be given to the owner.
- In certain cases, OFCOM may require the PV system to undergo a conformity assessment procedure.

3 Different types of photovoltaic systems

There are three different types of photovoltaic systems, which are described below.

3.1 PV system with an inverter

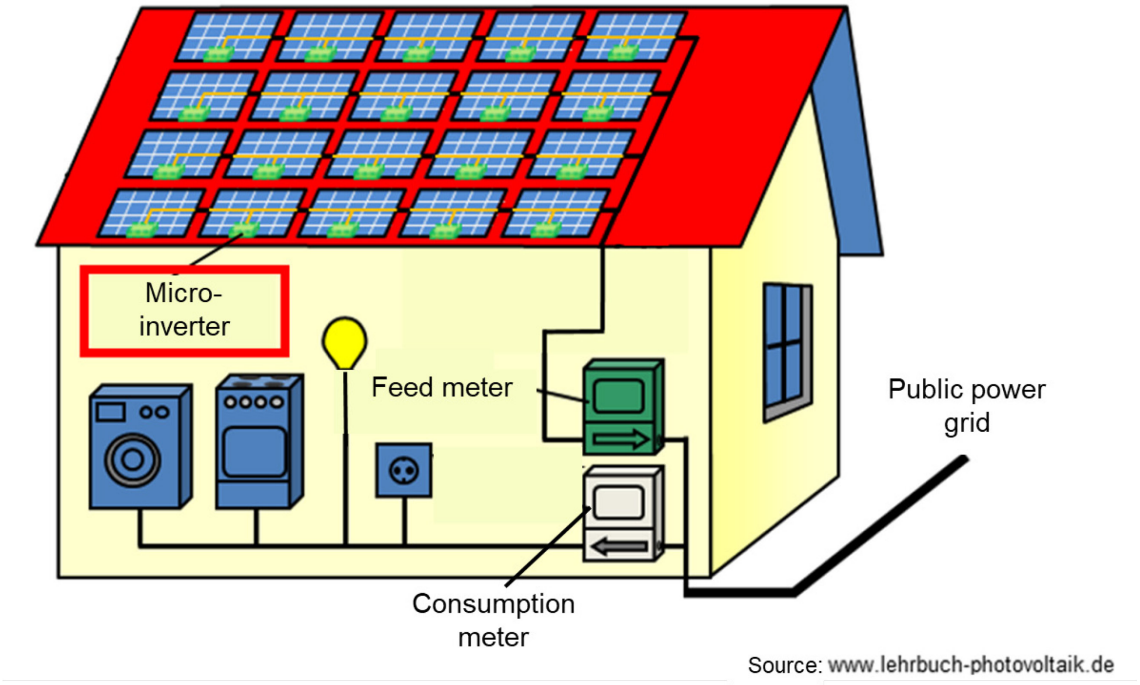
A PV system with an inverter (i.e. a device that converts direct current to alternating current) at the end of each string looks like this:



A string comprises a number of solar panels connected in series. The string conducts direct current to the inverter, where it is converted into alternating current. The alternating current can then either be used in the house or fed into the power grid.

3.2 PV system with microinverters

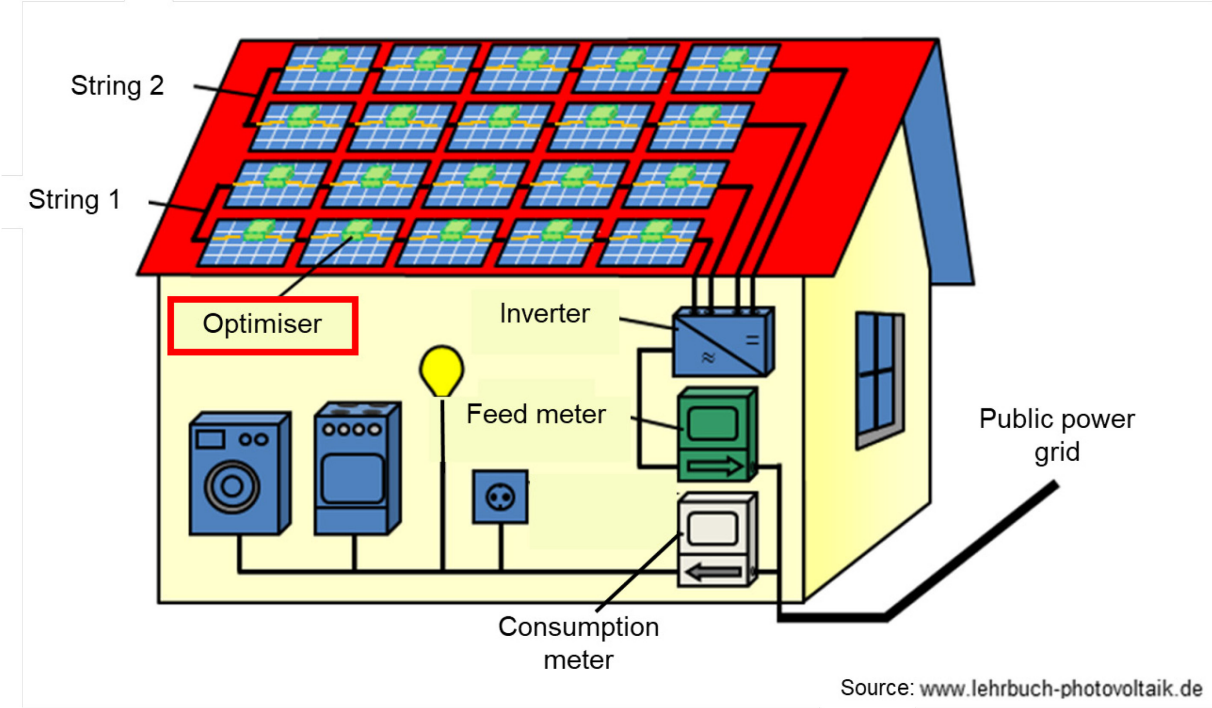
A PV system with a microinverter on each panel looks like this:



Each solar panel has its own microinverter. The direct current generated by the solar panel is therefore converted directly into alternating current. All microinverters are connected in parallel to an AC cable.

3.3 PV system with optimisers

A PV system with an optimiser on each solar panel and a single inverter at the end of all its strings looks like this:



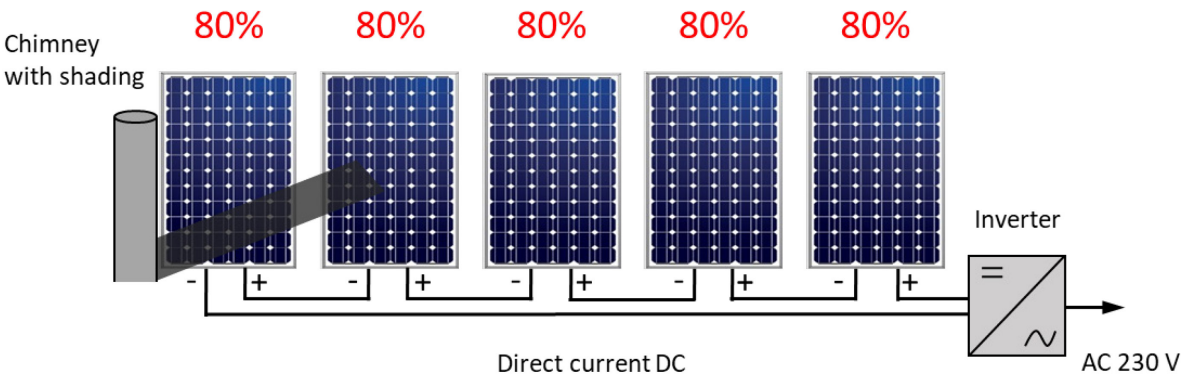
Each string has a number of optimisers connected in series. The optimisers are each connected to a specific solar panel. The way in which the optimiser functions is explained in Section 3.4. Here too, everything runs through a direct current cable, which is connected to the inverter. The inverter converts the direct current into alternating current.

3.4 Purpose of microinverters and optimisers

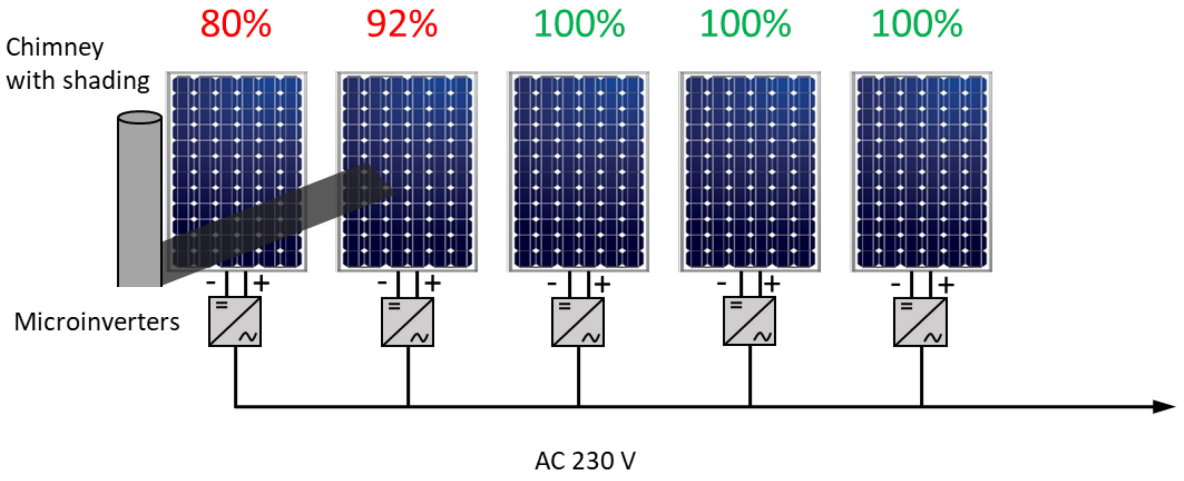
Microinverters and optimisers are modules that are connected directly to the solar panels. In the case of microinverters, optimisation takes place automatically simply because they allow the solar panels to be connected in parallel. This means that each solar panel can supply the maximum possible energy independently from the other panels in the system. When panels are connected in series, optimisers are necessary to regulate the energy production for each solar panel individually. Optimisation occurs when a part of the solar panel is temporarily shaded, e.g. by a tree, a chimney or by the shape of the roof.

In a conventional PV system, the shaded solar panel not only produces less energy but also limits the current produced by all the other panels in the same string (as they are connected in series), which means that they also produce less energy. The resultant loss of production in a conventional PV system can be considerable. Some examples are given below. The percentages are based on a freely chosen assumption.

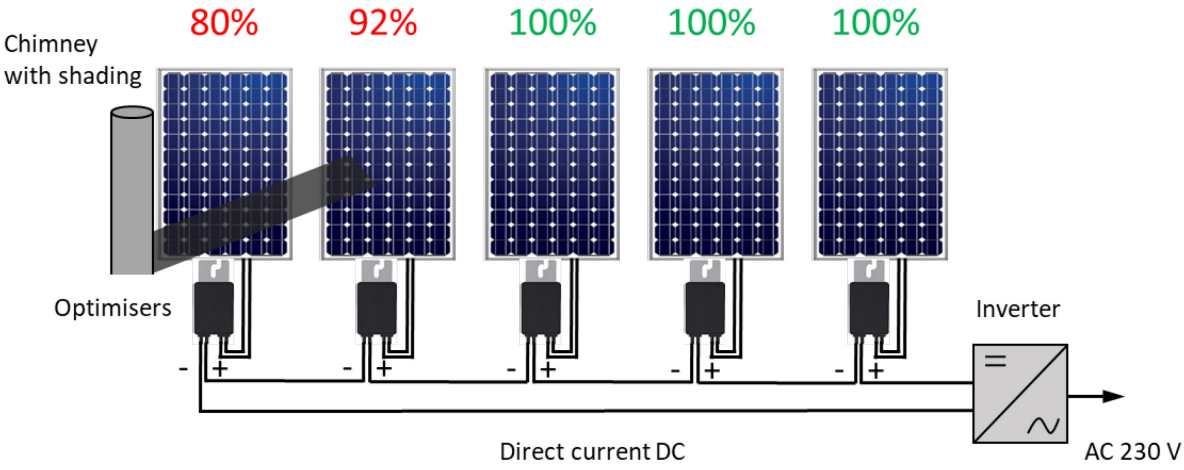
Photovoltaic system with a single inverter



Photovoltaic system with microinverters



Photovoltaic system with optimisers



3.5 Particular potential of optimisers for causing interference

Optimisers cause superimposed high-frequency interference because of the way that they affect direct current cables. As these cables can be of considerable length in PV systems, they act as antennae. The electromagnetic waves that they emit have a considerable impact on telecommunications, particularly in the short-wave range.

Under current regulations, optimisers that provide insufficient suppression of interference or that do not suppress interference at all can still be sold. Recently, the associated standard, EN 55011*, was amended to add Annex A2:2021, which closes this loophole in the requirements. However, manufacturers are not yet required to apply the new provisions. If the optimisers were to fulfil the new requirements, the potential for interference could be greatly reduced. The declaration of conformity (see also link [8]) indicates whether the manufacturer has already applied Annex A2:2021. Microinverters, on the other hand, must be interference-suppressed to prevent radio communications interference.

*Complete standard designation: EN 55011:2016+A1:2017+A2:2021

4 Interference

If OFCOM receives a report of interference on the radio spectrum, it carries out measurements to establish the cause. OFCOM assesses compliance with the essential requirements of a PV system based on a recommendation issued by the Electronic Communications Committee ECC (ECC Recommendation (09)02[2]). If OFCOM concludes that the requirements are not met, the owner or operator must modify the installation within a specified period. If the installation has not been modified or has been insufficiently modified by the deadline, OFCOM may order it to be switched off.

5 Inspection

OFCOM is entitled to check whether fixed installations that have been put into operation comply with the relevant legislation. It carries out control measurements if it has reason to believe that a PV system does not fulfil the legal requirements.

6 Further legal provisions

The Ordinance on Electromagnetic Compatibility (OEMC) lays down the relevant legal principles.

If a PV system also includes a wired communication system or has an integrated radio communication module, it is deemed to be a telecommunications system. In this case, the Telecommunications Act (TCA) [3] and the related implementing ordinances also apply. These are the following:

- Ordinance on Telecommunications Installations (TIO) [4]
- Ordinance on the Use of the Radio Frequency Spectrum (RFSO) [5]
- OFCOM Ordinance on the Use of the Radio Frequency Spectrum (ORFSO) [6]
- Ordinance on Fees in the Telecommunications Sector (FeeO-TCA) [7]

They apply both to operational requirements and in the event that interference is caused.

7 Useful links

Links to topics related to this information sheet are provided below.

[1] Ordinance on Electromagnetic Compatibility (OEMC):
https://www.fedlex.admin.ch/eli/cc/2016/18/en

[2] ECC Recommendation (09)02:
https://docdb.cept.org/download/1824

[3] Telecommunications Act (TCA):
https://www.fedlex.admin.ch/eli/cc/1997/2187_2187_2187/en

[4] Ordinance on Telecommunications Installations (TIO):
https://www.fedlex.admin.ch/eli/cc/2016/24/en

[5] Ordinance on the Use of the Radiocommunications Frequency Spectrum (RFSO) (not in English):
https://www.fedlex.admin.ch/eli/cc/2020/1024/de

[6] OFCOM Ordinance on the Use of the Radiocommunications Frequency Spectrum (ORFSO) (not in English):
https://www.fedlex.admin.ch/eli/cc/2020/914/de

[7] Ordinance on Fees in the Telecommunications Sector (FeeO-TCA) (not in English):
https://www.fedlex.admin.ch/eli/cc/2020/1028/de

[8] Information on the subject of the declaration of conformity:
https://www.bakom.admin.ch/bakom/en/homepage/equipments-and-installations/market-access-of-electrical-apparatus/declaration-of-conformity.html

8 Further information on this topic

The following links lead to other articles that have been published on this topic.

[1] OFCOM Infomailing 43 on the installation of PV systems (not in English):
https://www.bakom.admin.ch/bakom/de/home/das-bakom/medieninformationen/bakom-infomailing/bakom-infomailing-43/photovoltaik-anlagen-vermeidung-von-moeglichen-stoerungen-bei-funkfrequenzen.html

[2] Article on optimisers in the Electrosuisse Bulletin (not in English):
https://www.bulletin.ch/de/news-detail/optimizer-nur-ein-hype-oder-die-zukunft.html

[3] Article on PVA with interference risk for radio frequencies from the eco2friendly magazine (not in English):
https://issuu.com/eco2friendly/docs/eco2friendly-de-01-2021_web/s/13308883