Danfoss

Application paper | VACON® 100 with Solar Pump application

Flexible efficient pumping in arid regions - also for many other applications

35%
more yield is possible than with traditional technologies

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Solar Pump application for lower emissions

For flexible efficiency in arid regions, the Solar Pump application is a good choice. Solar Pump allows flexible use of VACON® 100 X drives, developed to drive Solar Pump with an optimized maximum power point tracker (MPPT) supplied by solar panels. The Solar Pump application uses its MPPT4 algorithm to extract the maximum possible solar power throughout the daylight hours.

At present, the system of energy distribution is centralized and energy is obtained from large power plants. These plants are often of the traditional type and produce high levels of polluting emissions during their generation processes. An example would be thermal or combined-cycle plants. Therefore, replacing grid-based energy consumption with self-generated energy using emission-free energy sources means a reduction in the pollution generated.

The Solar Pump application enables a pump to run on electricity generated by photovoltaic panel with a range of key benefits:
- Power supply for remote areas, where electricity is not otherwise available
- Power independent from conventional energy (off-grid solution)
- Power supply is uninterrupted during daylight hours
- Power source is clean, low carbon, and eco-friendly

An opportunity exists for water industry professionals, since many governments are subsidizing the swap from fossil-fuel-powered generators to solar-supplied systems.

The Solar Pump solution can contribute significantly with reliable water supply to enable more agricultural yield, reduce poverty, and sustain economic growth. Typical applications are in plant or animal agriculture, and rural drinking water supply.

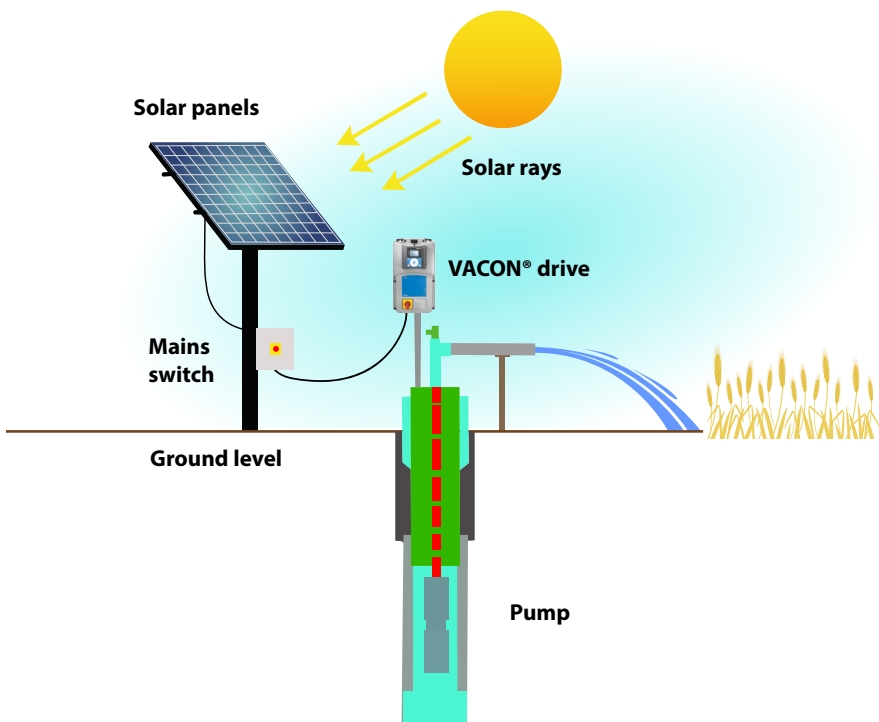| Field	Plant agriculture	Animal farming	Rural community water supply
Application	■ Flood, drip or furrow irrigation	■ Improved livestock breeding ■ Cattle watering system	■ Access to clean drinking water ■ Hygienic and sanitation access

Figure 1: Solar Pump application overview

Why MPPT4 ?

The advantage of using VACON® 100 drives with the Solar Pump application lies in the optimization of the energy flows: on the one hand, solar power generation is maximized and, on the other, demand for power is minimized. The optimization of solar power production is based on MPPT4 control. Thanks to its four parallel operating algorithms, the set value, which ensures the extraction of the maximum power available for the environmental conditions, is monitored and controlled at all times.
In this way, a 35% greater yield is possible, compared with traditional technologies. The extra 35% yield translates into more operating time and ultimately, more water volume pumped. Furthermore, the drive itself adjusts the energy consumption of the pumps which it supplies, either through the panels or the network, to the exact needs of the customer, which reduces the demand for energy by the system. As a result, the energy consumed through the network is reduced and this equates to financial savings and a reduction in polluting emissions.

Features	Benefits
MPPT[4] (Maximum Power Point Tracker) ■ The drive constantly aims to extract maximum power from the solar panels by maintaining the DC voltage at the optimum point	■ Obtains maximum power for any given environmental conditions ■ Local maxima bypass logic ■ Provides more generated output power ■ Increases the amount of pumped water ■ Extends the pump working time during daytime
■ IP66/ Type 4X outdoor drive without cabinet Stand-alone full feature factory tested solution ■ Gore vent against moisture and condensation ■ Electronic components required can be placed together with the string box in a smaller sealed cabinet which doesn't require additional cooling.	■ Compact and maintenance free solution: no air filter to replace/clean ■ No additional cooling required
Dual supply mode ■ Can be used to ensure full water flow when required at nighttime or in poor daylight ■ Dual supply mode can be used through 2 ways, changeover switch and power supply blending	■ Dual supply mode using changeover switch ensures safety ■ Dual supply mode using power supply blending ensures uninterrupted water flow and break
Built-in EMC filter	Reduce complexity with fewer external components
Remote access via network connection for monitoring, configuration and trouble shooting	Save time and cost by eliminating travel
Real-time clock and timer functions ■ Program up to 3 time channels to achieve different functions on the drive	Reduce complexity with fewer external components
External PID-controller ■ Control external components such as a valve, from the drive I/O	Flexible extended functionality independent of the PLC
Zone PID-controller	2 different feedback signals
Process value supervision	
Dry run protection	
Built in flow measurement	

Additional functions

- Maximum ambient temperature up to 50/60°C with derating
- Solar supply up to 800 VDC
- Current limit function
- Trend curves
- Multimonitor
- Parameter supervision

- Temperature operation range and current limiting at high-temperature environment
- Parameter set 1/2 selection P3.5.1.30
- Timer functions G3.12 (intervals & off delay counters)
- Maintenance counter G3.16 (revolutions or runtime)
- Drive customizer G3.19

- Autocleaning G3.21
- Panel/motor ratio P3.22.2.3
- Flowmeter G3.23 (Digital pulse or Analogue)
- Brake chopper G5.6.3 (Capacitor over-voltage protection)
- Harmonic Filter P5.6.7
- Sine filter P5.6.6

Solar pump drive: how does it work?

The integrated MPPT (Maximum power point tracker) is a real 4-algorithm control scheme which generates maximum solar power for the given environmental conditions.

For simpler controllers (under-voltage regulators), the controller reduces the pump speed, thus reducing the absorbed power, once the DC voltage hits a minimum set level. This means that solar panels do not produce enough energy to maintain the required speed, and the solar panels usually work at a non-optimal voltage.

For advanced controllers, the drive strives to extract maximum power from solar panels by keeping the DC voltage at the optimum point (MPP=Maximum Power Point).
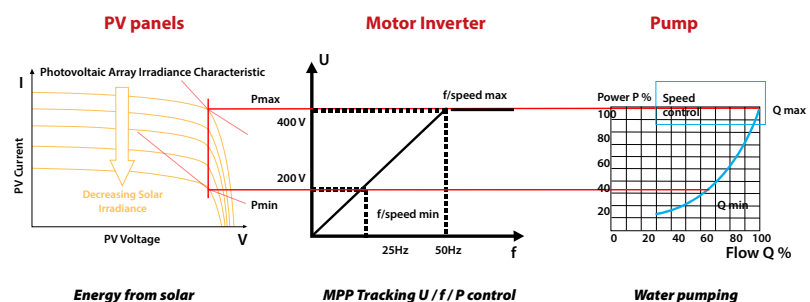

Figure 2: How the solar pump drive works

MPPT4 application

MPPT4 is a dedicated application software for solar pump drives, with a multiple algorithm MPPT (Maximum Power Point Tracker) optimized for implementation in VACON® 20 X, VACON® 100 X and VACON® 100 drives.

The unique MPPT4 controller implements 4 concurrent algorithms to generate maximum solar power for the given environmental conditions:

- Feed-forward controller, to follow the radiation variations
- Correction controller, to compensate for temperature variations
- Oscillation damping regulator, to catch-back the panels entering "current source mode"
- Local maxima bypass logic, to skip the "false" maximum point during partial irradiation

Dual supply mode is also known as power blending. Use dual supply mode (power blending) when full water flow is required at nighttime or in poor daylight. In practice, this means that an AC mains supply delivers power when there is not enough DC voltage available from solar panels.

- Danfoss solar pump drives are industrial drives powered from the grid as standard. There are two ways of doing this:
  - Using switchover switch with delay from AC to DC
  - Dual supply (AC and DC) connected to the drive continuously at the same time

How to order
To order a drive and equip it with the Solar Pump application:

1. Order your drive/s from the Danfoss Product Store or your local Danfoss office.
- Order VACON® 100 INDUSTRIAL and VACON® 100 X with plus code +A1181
- Order VACON® 20 X with plus code +A1163
- For larger OEM projects, order VACON® 20 Cold Plate in the same power rating as VACON® 20 X, with plus code +A1163

Note: VACON® 100 FLOW does not support solar pump

2. Download the solar pump application (AMIT1181) into VACON® 100 INDUSTRIAL and VACON® 100 X drives, via license code. Create a license in the VACON® KEY tool, free of charge.

Safety note
For dual supply, safety measures must be in place in the event of a drive rectifier fault while AC supply power is down. In these circumstances, it is possible that dangerous DC voltage from solar panels can go as far as galvanically possible. The system supplier must include a system to prevent exposure to DC voltage, in these circumstances.