

# Efficient and Reliable Pump Control for Modern Agricultural Irrigation

Applications



Optidrive variable frequency drives optimising irrigation control, lowering energy usage, reducing costs, and boosting farm efficiency.

# Enhancing agricultural irrigation efficiency with variable frequency drives (VFDs)



## An Invertek Drive will give you:

### Save energy and reduce operating costs

- ✓ **Energy savings:** By optimising water flow to match the demand, VFDs can significantly reduce energy consumption while maintaining peak performance.
- ✓ **Utilise solar power sources:** VFDs can be used in solar-powered irrigation systems, offering a more sustainable and cost-effective solution. Dedicated solar pump drives ensure easy and seamless integration.

### Simple, robust, and reliable

- ✓ **Robustness:** Optidrive are designed to withstand harsh environments with protected circuit boards and coated heatsinks together with high-ingress protection, IP55 and IP66 outdoor models.
- ✓ **Ease of use:** Simplicity of installation, connection, and commissioning with Optidrive, ensures fast and simple integration.

### Protect your water resources

- ✓ **Preserve water resources:** VFDs allow for smarter, more precise control of pumps ensuring you only pump what your crops require.
- ✓ **Extended life:** Optimised pumping reduces the strain on wells with built-in pump protection features, leading to longer well life and fewer maintenance issues.

### Extend your asset life

- ✓ **Reduced mechanical wear:** Smooth starting and stopping of pumps, enabled by VFDs, minimises mechanical stress and wear on pumps and other system components.
- ✓ **Pump protection:** Inbuilt features such as run-dry protection, blockage detect/clear, burst-pipe detection, and pump stir cycle help to extend asset life and reduce downtime, lowering your maintenance costs.

VFDs provide a simple and efficient way to manage agricultural irrigation, leading to significant benefits in terms of energy consumption, costs, and operational efficiency.

$$\text{Power} \propto \text{Speed}^3$$

**10% speed reduction**  
**~27% energy reduction**

## Lower Energy Consumption Across Irrigation Seasons

Most irrigation systems are sized for peak demand; however, they rarely operate at peak flow or pressure for extended periods. Traditional fixed-speed pumps either pump more water than is required, which wastes energy and valuable water resources, or are throttled to reduce flow and pressure, which also wastes energy.

VFDs reduce energy use by matching the pump speed to the flow demand without the need to throttle. Where required, pump speeds can be pre-configured with smart profiles to match a range of different scenarios and seasonal requirements (e.g., night irrigation, early crop stages, weather).

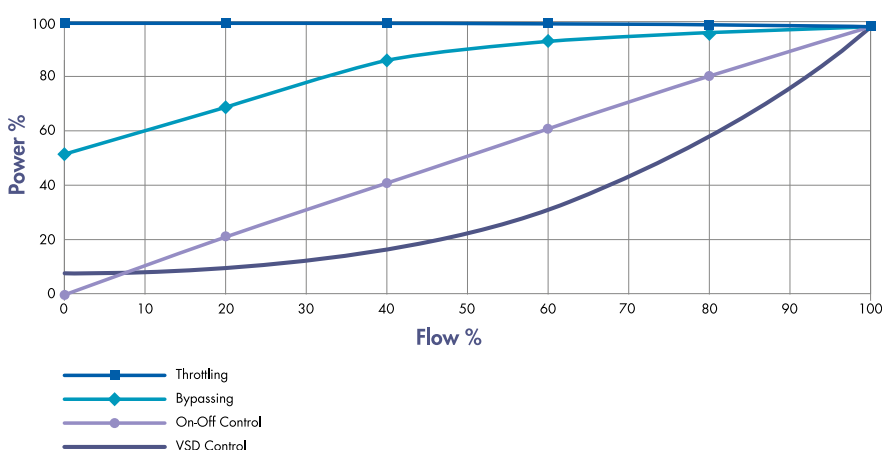
In typical agricultural pumping applications, farms can often achieve a 20–60% reduction in energy consumption or reduced generator fuel usage in off-grid systems. These savings accumulate, delivering a fast return on investment and significantly reducing lifetime operating costs.

### Typical savings examples

| Speed reduction | Energy saving     | Explanation                               |
|-----------------|-------------------|-------------------------------------------|
| 10% slower      | ~27% energy saved | Power drops with the cube of speed        |
| 20% slower      | ~49% energy saved | Nearly half the energy used at full speed |
| 30% slower      | ~66% energy saved | Two-thirds energy reduction               |
| 40% slower      | ~78% energy saved | Significant savings in low-demand periods |

These figures are industry-standard and widely used in irrigation, water supply, and pumping applications.

### Pump cube law



Ideally, centrifugal pumps follow the affinity law where power is proportional to the cube of speed ( $P \propto n^3$ ).

When controlling flow rate or speed, a VFD allows the pump to operate much closer to this ideal relationship compared to traditional control methods such as throttling or bypassing.

As a result, VFD control enables significantly lower energy consumption at reduced flow rates, delivering substantial efficiency improvements over conventional approaches.

# Applications

## Borehole, River & Reservoir Pumping

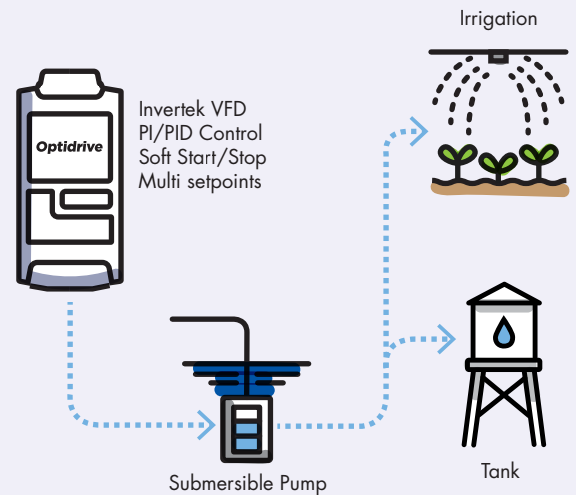
Common in mixed-use and large agricultural estates

### Inverterk Solution

- Controlled ramp-up protects borehole/pump integrity (multiple programmable ramp rates)
- Dry-run and low-load detection protects pumps

### Benefits

- Energy Optimisation through matching pump speed to required irrigation demand
- Constant pressure delivery regardless of water level changes
- Extended pump and well lifetime



## Seasonal & Crop-Specific Irrigation Profiles

Different crops have different water needs throughout the year.

### Examples

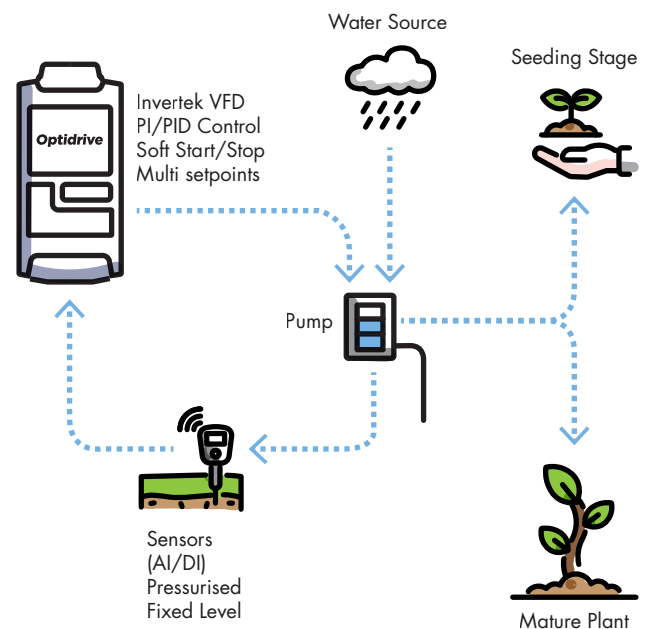
- High flow during peak growth
- Reduced flow during establishment or dormancy
- Intermittent irrigation during weather-driven demand

### Inverterk Solution

- Store multiple irrigation profiles
- Automatic switching by time, season, or sensor input (soil moisture levels)
- No external PLC required

### Benefits

- Easily optimise profiles to application specific requirements
- Reduced cost due to reduction of external components for control programming



## Multi-Zone Fields & Large-Scale Irrigation Networks

Used in arable farming, orchards, vineyards, and pasture irrigation

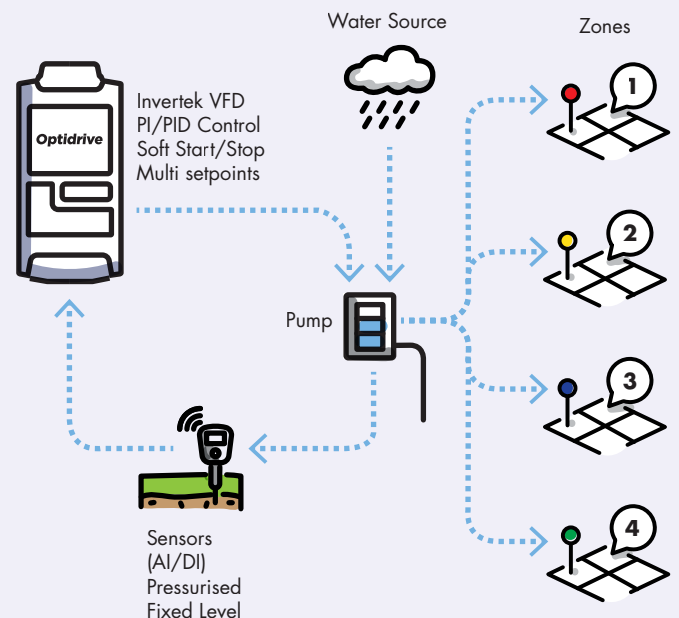
### Inverterk Solution

VFD control adjusts output to active zones (switching between zones)

- Integrated PI/PID control
- Optiflow Multiple pump operation without external PLCs

### Benefits

- One pumping station, multiple field requirements
- Eliminates pressure-reducing valves
- Consistent irrigation across varying terrain
- Retains constant pressure when opening and closing zones



## Solar-Powered Irrigation & Remote Pumping

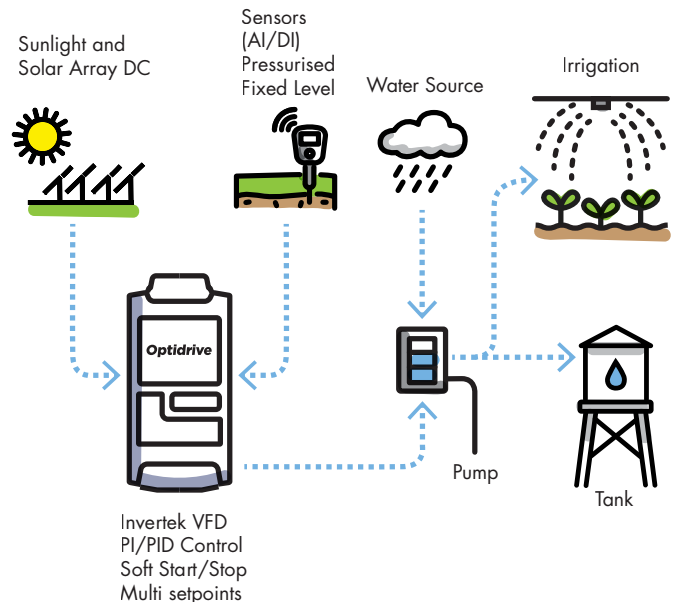
Ideal for off-grid farms, boreholes, reservoirs, and livestock watering

### Invertek Solution: Optidrive P2 Solar

- Direct DC input from PV arrays with integrated MPPT
- MPPT Optimises available DC voltage maximising daily pumping hours
- Built-in dry run protection, pipe-burst detection, and tank level control
- Integrated PLC for autonomous operation without external controllers

### Benefits

- No mains power or batteries required
- Maximised water yield from available solar energy
- Reliable pumping in remote locations



## Case Study

### Solar-Powered Irrigation Using VFD Technology

#### Challenge

A lack of grid infrastructure resulted in reliance on inefficient diesel generators and fossil fuels to power submersible pumps used for tank filling and irrigation.

#### Solution

A dedicated P2 Solar pumping VFD, designed specifically to operate directly from PV arrays, was installed to control a submersible pump supplying the irrigation system.

#### Result

The system now delivers reliable pumping for up to 8 hours per day, with stable operation under changing solar conditions. Energy and fuel savings resulted in a return on investment within 18 months, while eliminating ongoing fuel costs and reducing environmental impact.

## Case Study

### Greenhouse Irrigation Using VFD Technology

#### Challenge

Greenhouse irrigation demand changes through the growth cycle, with different flow and pressure needs during establishment, peak growth, and lower-demand periods.

#### Solution

Optidrive ECO / Optidrive E3: VFD control with integrated PI/PID adjusts pump output to match changing demand, while Optidrive ECO can support profile-based operation where configured.

#### Result

More consistent irrigation, smoother operation as crop demand changes, and reduced wear on pumps and pipework over the season.

## Greenhouses & Controlled Environment Agriculture

Precision irrigation for high-value crops

### Typical Requirements

- Low flow for seedlings
- Higher flow for mature plants
- Seasonal and daily variability

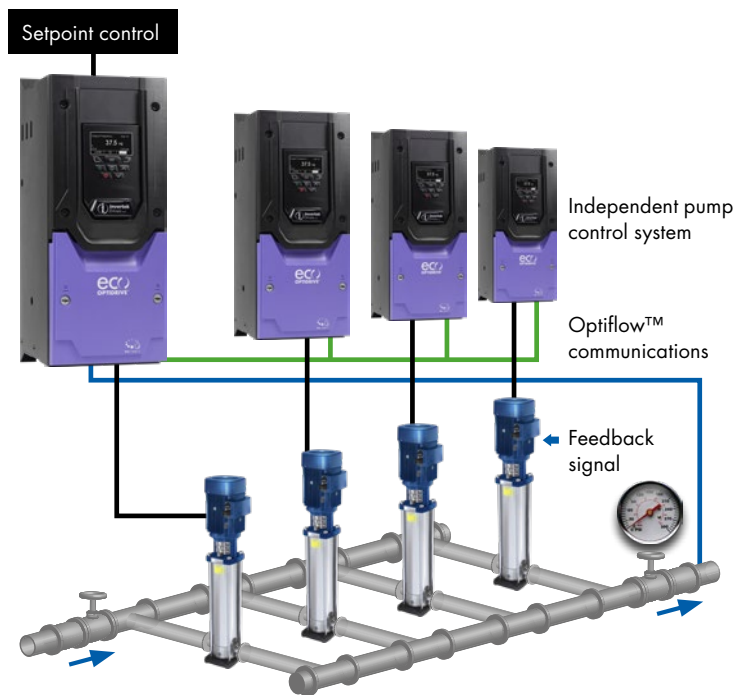
### Invertek Solution

- Fine speed control for drip, misting, and spray systems
- PI/PID-controlled based on sensor feedback (moisture, pressure, flow)
- Soft start eliminates hydraulic shock to pipework and fittings
- PLC Programming for crop specific demand over crop lifecycle

### Benefits

- Uniform crop watering
- Improved yield consistency
- Reduced water and energy waste

# Booster Pump Application



## Simple Connection

Additional drives connected on the system require a single RJ45 connection and basic commissioning, leading to time savings and simplified installation.

## Flexible Solution

The system can operate with up to five pumps in any configuration, e.g., Jockey Pump / Duty / Assist / Standby. Duty pumps are automatically rotated, ensuring maximum service life and system efficiency.

The pump controller automatically balances pump operating times, reconfigures the system in case of pump failure (including master drive) and indicates maintenance intervals for each pump individually. System operation is maintained even if drives are individually powered-off and are automatically re-introduced into the system, when powered on.



**IP20**



Suitable for installation within an electrical cabinet. Mounting options – screw fixing or DIN rail mounting for easy cabinet integration.

**Operating Temperature Range**  
-10°C to +50°C (without derating)



**IP55**



Wall-mounted installation – suitable for indoor or outdoor mounting. The enclosure should be protected from extreme weather conditions.

**Operating Temperature Range**  
-10°C to +50°C (up to +40°C without derating)



**IP66**



Wall-mounted installation – high performance outdoor enclosure, fully dust-tight, and protected against severe weather conditions, including powerful water jets and washdown environments.

**Operating Temperature Range**  
-10°C to +50°C  
(up to +40°C without derating)

**3 YEAR WARRANTY**

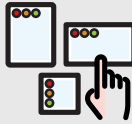
**NOW STANDARD ON ALL OPTIDRIVES**



**Warranty Plus+**

Warranty Plus+ is available on all Optidrive Eco and extends the warranty to 5 years from the date of manufacture.

# Pumping Features

|                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p><b>Standby mode</b><br/>Reduces energy consumption and mechanical wear by pausing the drive when demand is low, then automatically restarting when process requirements increase.</p>                                                                    |  <p><b>Dual Ramp Rate</b><br/>Quickly accelerates to minimum speed to protect thrust bearings, then transitions to a standard ramp rate. This extends pump life, ensures reliability, and prevents unplanned outages.</p>                      |
|  <p><b>Pump Stir Cycle</b><br/>Runs a customizable cleaning cycle after a set period of inactivity to clear sediment, ensuring the pump stays reliable and ready for use.</p>                                                                                |  <p><b>Pump Clean</b><br/>Detects pump blockages and triggers an automatic cleaning cycle to clear them, preventing downtime and maintaining continuous operation.</p>                                                                        |
|  <p><b>Pump Prime with Burst Pipe Detection</b><br/>Safely fills and pressurizes the system, automatically shutting down the pump if pressure isn't reached within a set time to protect against leaks or burst pipes.</p>                                   |  <p><b>Load Monitoring (Pump Protection)</b><br/>Monitors the motor current profile to evaluate pump speed and power. It automatically triggers a warning or shuts down the system if it detects a dry pump, blockage, or broken impeller.</p> |
|  <p><b>Optiflow (Multi Pump):</b><br/>Coordinates multiple pumps with automatic staging and load balancing to optimize efficiency and maintain stable pressure. It ensures continuous demand coverage, even during pump failure or isolated maintenance.</p> |  <p><b>Function Block Editor</b><br/>Create and customise control logic quickly using an intuitive graphical interface with interconnected function blocks</p>                                                                                 |
|  <p><b>MPPT (Maximum Power Point Tracking)</b><br/>Continuously adjusts pump speed to match changing operating conditions, extracting maximum power from the solar array to maximize overall efficiency and performance.</p>                                |  <p><b>Delayed Restart</b><br/>Prevents the pump from repeatedly starting and stopping during low-solar conditions. The drive enters a low-power standby mode and only restarts once sufficient voltage is available.</p>                     |

## Optidrive™ E3

## OPTIDRIVE™ Eco

## OPTIDRIVE™ P2 SOLAR

|                              | E3                       | Eco                      | P2 Solar                           |
|------------------------------|--------------------------|--------------------------|------------------------------------|
| <b>Voltage Range</b>         | 110-400V                 | 200V-600V                | 200V-600V                          |
|                              | Single and 3 phase input | Single and 3 phase input | Direct DC connection form PV array |
| <b>IP20</b>                  | 0.37-37kW                | 0.75-250kW               | 0.75-250kW                         |
| <b>IP55</b>                  | -                        | 7.5-250kW                | 5.5-250kW                          |
| <b>IP66</b>                  | 0.37-22kW                | 0.75-30kW                | 0.75-30kW                          |
| <b>PID</b>                   | PI only                  | ✓                        | ✓                                  |
| <b>Standby/Sleep mode</b>    | ✓                        | ✓                        | ✓                                  |
| <b>Dual Ramp rate</b>        | ✓                        | ✓                        | ✓                                  |
| <b>Burst Pipe</b>            |                          | ✓                        | ✓                                  |
| <b>Load Monitoring</b>       |                          | ✓                        | ✓                                  |
| <b>Pump Stir</b>             |                          | ✓                        | ✓                                  |
| <b>Pump Clean</b>            |                          | ✓                        | ✓                                  |
| <b>Optiflow (multi-pump)</b> |                          | ✓                        |                                    |
| <b>MPPT</b>                  |                          |                          | ✓                                  |
| <b>Delayed start/stop</b>    |                          |                          | ✓                                  |
| <b>Function Block Editor</b> |                          | ✓                        | ✓                                  |

# Boost crop growth with precision irrigation systems

Precise irrigation not only saves water and energy cost, it also helps optimise plant growth by providing precise amounts of water at required intervals that vary according to environmental conditions.

Variable frequency drives provide a simple and cost effective way to achieve the ideal watering regime. Whether it's for crop growing or maintaining landscapes, such as lawns and racecourses. VFDs can help you achieve the most efficient and productive irrigation solution.



[www.invertekdrives.com](http://www.invertekdrives.com)

**INVERTEK DRIVES LIMITED** UK Headquarters

Offa's Dyke Business Park  
Welshpool, Powys, UK  
SY21 8JF

**Tel:** +44 (0)1938 556868  
**Fax:** +44 (0)1938 556869  
**Email:** [sales@invertekdrives.com](mailto:sales@invertekdrives.com)

