

Invertek Optidrive P2 Variable Frequency Drives (VFDs)



Invertek Optidrive P2 family of high-performance VFDs (various frame sizes shown). The P2 series covers a wide power range and offers heavy-duty ratings for demanding applications ¹ ².

The **Invertek Optidrive P2** is a high-performance AC **Variable Frequency Drive (VFD)** designed for challenging industrial and commercial motor control applications. It supports input voltages from 200 V up to 600 V (single- or three-phase) and is available in power ratings from 0.75 kW to 250 kW (1 – 400 HP) ¹. Each drive is built with an **industrial heavy-duty rating**, capable of 150% overload for 60 seconds (and even 200% overload for short 4-second bursts) to handle high starting torque and shock loads ². Despite its advanced capabilities, the Optidrive P2 is engineered for ease of use – with a fast setup, intuitive keypad interface, and flexible mounting options – allowing users to **deploy sophisticated motor control without complex commissioning**. In the sections below, we delve into the P2's technical specifications, features, and real-world performance that make it a standout solution for variable speed motor control.

Key Technical Specifications and Capabilities

Voltage and Power Range: The Optidrive P2 series spans a broad range of motor sizes and supply voltages. Standard models accommodate 200–240 V (up to 75 kW) and 380–480 V mains (up to 250 kW), as well as higher 575 V inputs (up to ~110 kW) for global compatibility ³. Both **single-phase and three-phase** supply versions are offered in the lower voltage ranges, useful for smaller motors or locations with only single-phase available. Across all sizes, the drives deliver full **constant torque** performance within their ratings, and can be applied to variable torque (e.g. fans, pumps) or constant torque (e.g. conveyors, compressors) loads alike. The **output frequency** can be programmed from 0 up to 500 Hz (0.1 Hz

resolution) ⁴ ⁵, enabling high-speed motor applications or specialized scenarios like high-frequency spindles. This wide frequency range is complemented by a high PWM carrier frequency (effectively 4 kHz up to 32 kHz) for smooth motor operation ⁶ ⁷.

Heavy-Duty Operation: Every Optidrive P2 is built with heavy-duty use in mind. The 150%/60 s overload capacity (with 180–200% peak for a few seconds) is available **in every control mode and enclosure type**, ensuring even the most demanding starting and accelerating conditions can be handled without oversizing the drive ². For example, the P2 can produce up to **200% of rated torque at zero speed** in sensorless vector mode, providing excellent breakaway torque for stuck loads or hoisting applications ⁸. This high overload tolerance is a key requirement for heavy industrial moves, and the P2 meets it across its entire power range. The drive's efficiency is also high – typically around **98% efficient** at full load ⁹ – meaning minimal energy is wasted as heat. An internal cooling fan (with smart temperature control) and robust heatsink design maintain safe temperatures during continuous operation. The drives are designed for ambient temperatures of –10 °C up to 50 °C without derating (higher with derate), and can even operate to 60 °C in storage or with proper current derating ¹⁰. Installation at altitudes up to 1000 m is supported without derating (and up to 2000 m with UL certification, or 4000 m maximum in non-UL situations) ¹¹. These specifications highlight that the P2 is engineered to **withstand harsh conditions** while delivering reliable performance.

Enclosure Options (IP20, IP55, IP66): Invertek offers the P2 drives in multiple enclosure ratings to suit different environments. **IP20 (open chassis)** units are compact and intended for clean, control-panel mounting. They cover the full power range up to 250 kW and can be side-by-side mounted to save panel space ¹² ¹³. IP20 models include features to simplify panel integration, such as keyhole slots for quick mounting and plug-in terminals. **IP55** enclosed models provide a dust-protected, water-resistant housing for wall-mount applications on the factory floor. The IP55 range spans from frame size 4 up to size 8 (covering up to 250 kW as well) ¹⁴. These sealed drives can tolerate harsher industrial environments (dusty or where occasional water spray occurs) – each IP55 P2 is built to run at –10 °C to 50 °C ambient and is fully heavy-duty rated ¹⁵. For the most extreme conditions, **IP66/NEMA 4X “Outdoor Rated”** versions of the P2 are available in sizes up to 7.5 kW (10 HP) ¹⁶. The IP66 units come in a rugged polycarbonate enclosure that is **dust-tight and washdown-ready**, suitable for direct machine mounting in outdoor or washdown environments ¹⁷ ¹⁸. All circuit boards are conformally coated for protection against humidity and corrosive agents ¹⁶. These models are ideal for applications like food and beverage processing (which require high-pressure washdown for hygiene) or outdoor pumping stations. *For instance, the IP66 P2 drives are constructed to resist UV light, oils, and acids, and remain impact-resistant even down to –20 °C without becoming brittle* ¹⁹ ²⁰. The availability of a **NEMA 4X** grade solution means that Optidrive P2 can be deployed virtually anywhere – from clean control rooms to dusty mills, outdoor wells, or marine docks – **without needing additional enclosures**. This flexibility in form factor is a significant benefit, reducing the need for separate cabinets in remote or harsh environments.



Inverter Optidrive P2 in IP66/NEMA 4X outdoor-rated enclosures. These fully sealed drives are UV-resistant and washdown-capable (dust-tight and rain-proof), making them suitable for exposed installations in food processing or outdoor pumping stations ²¹ ²² .

Beyond ingress protection, the P2's physical design includes thoughtful details to simplify installation and maintenance. All sizes use **large, rising-clamp terminals** (5 mm) with captive screws for easy power and control wiring ²³ . The drives also feature an **integrated cable management** system and optional DIN-rail mounting on smaller frames for quick panel assembly ²⁴ . An **integrated help card** is included on the drive, giving a quick reference to basic programming and diagnostics without needing to reach for a manual ²⁵ . Cooling fans are high-quality, long-life units to maximize reliability ²⁶ . For the largest frame sizes, Inverter offers accessory **"Size 8" gland boxes** and other installation kits to assist with mounting and cabling of these bigger drives ²⁷ . All these design elements underscore the P2's focus on **combining high performance with practical usability**, ensuring that advanced functionality does not come at the expense of ease of installation or operation.

Advanced Motor Control Features

One of the Optidrive P2's greatest strengths is its **versatile motor control capability**. It is truly a **universal motor drive**, capable of controlling almost any AC motor type without requiring complex setup or feedback devices. The drive supports multiple control modes:

- **V/F (Volts/Hz) Control:** A basic scalar control suitable for simple applications or multiple motor operation. Inverter includes an **"Energy Optimised V/F"** mode that automatically reduces voltage to the motor under light load conditions to improve efficiency ²⁸ . This is useful for fans, pumps, or any variable torque load where running at reduced magnetization can save energy.
- **Open-Loop Vector Control (Sensorless Vector):** Inverter's latest-generation 3GV sensorless vector control algorithm provides precise speed and torque control **without needing an encoder** on the motor ²⁸ . In sensorless vector mode, the P2 can deliver very high starting torque (up to 200% at zero speed) and tight speed regulation under changing loads ⁸ . This mode is ideal for demanding applications like cranes, hoists, crushers, extruders, or any machinery that requires rapid torque response and stable speed holding. Notably, the Optidrive P2's vector control is tuned to work with **a wide range of motor types**, not just standard induction motors. It can self-calibrate to control

Induction Motors (IE2, IE3, etc.), Permanent Magnet AC motors (PM or IPM), Brushless DC motors (BLDC), and even modern Synchronous Reluctance Motors (SynRM) ²⁹ . Few general-purpose drives in the market offer such breadth – this means the same P2 drive unit can run a standard AC motor today and can be repurposed to run a high-efficiency **IE4 PM motor or an IE5 SynRM motor** in the future, offering **future-proof flexibility** ²⁹ ³⁰ . (By comparison, major drives from other manufacturers also emphasize multi-motor compatibility: for example, ABB's ACS880 series can “**enjoy premium control of virtually any type of AC motor**” including induction, permanent magnet and SynRM machines via its DTC technology ³¹ . The Optidrive P2 achieves a similar outcome using advanced sensorless vector algorithms – ensuring end-users are not locked into one motor technology.)

- **Closed-Loop Vector Control (Encoder Feedback):** For applications demanding ultimate precision at very low speeds or zero speed holding (such as position control or synchronized line speed applications), the Optidrive P2 also supports closed-loop operation with an optional encoder feedback module ²⁸ . In closed-loop mode, the drive can perform true **speed or torque control** with feedback, allowing **full torque at standstill** and creep-speed control with high accuracy ²⁸ . This is particularly useful in crane hoists (for slip-free holding of loads), elevators, or winding/unwinding systems that require tension control. The fact that P2 can be software-configured for closed-loop control means it can tackle servo-like tasks when needed, using an incremental encoder input. (This capability is often found only in high-end drives – for instance, Eaton's SPX series drives support closed-loop feedback and even **operate PM motors with very precise control**, targeting high-performance needs ³² ³³ . Invertek's P2 brings similar high-end features into a relatively compact, easy-to-use package.)
- **Permanent Magnet & Special Motors:** As noted, the Optidrive P2 can control **PMAC** and **BLDC motors** either in vector mode (sensorless) or with an encoder (if required for low-speed torque). The drive provides parameter sets and an auto-tune procedure to adapt to PM motor parameters, enabling efficient use of these motors' high torque density. It also has a mode for **Line-Start Permanent Magnet (LSPM)** motors ³⁴ , which are hybrid motors that can run across the line or on a drive. Additionally, the P2 natively supports **synchronous reluctance motors**, which are becoming popular for IE4+ efficiency without rare-earth materials ²⁹ . This wide motor compatibility places the Optidrive P2 among the most flexible drives in its class. (Hitachi's latest SJ-P1 series VFD, as another example, advertises dual capability for induction and PM motors with special features to maintain high torque at low speeds ³⁵ ³⁶ . The industry as a whole is moving toward VFDs that handle multiple motor types, and the P2 is fully in line with that trend.)

Dynamic Performance: Under vector control, the P2 provides excellent dynamic response and torque accuracy. Invertek has developed advanced mathematical algorithms and uses high-speed hardware to achieve this. The drive's **torque response** and speed settling times rival those of much larger drives or servo systems, which means it can be trusted in critical applications like hoisting. The **starting torque** capability (200% at 0 Hz) ensures reliable starting of heavy loads or overcoming friction without the need for an oversized motor ⁸ . Acceleration and deceleration ramps are fully programmable (from 0.01 to 600 seconds) to allow smooth control of inertia and to avoid mechanical shocks ³⁷ . For rapid stops, the P2 can use **configurable braking methods**: it has a built-in DC injection braking function (to lock the rotor at standstill), and every unit size **includes an integral brake transistor** (chopper) for dynamic braking with an external resistor ³⁸ ³⁹ . This is an important feature – the **integrated brake chopper** saves space and cost for applications that require quick stopping or regeneration (e.g., decelerating a high-inertia load). Users

simply wire an appropriate resistor to the P2's terminals to dissipate energy. By including the transistor in all models, Invertek ensures you don't need to step up to a higher series or add extra hardware for braking; it's ready out-of-the-box for high-duty cycles. (Many competitor drives likewise include such features on their high-performance lines – for instance, ABB's ACS880 drives come with built-in chokes, EMC filters, and brake choppers standard ⁴⁰. The P2's built-in filter and brake transistor ³⁸ show a similar “everything included” design philosophy for convenience.)

Precision and Stability: With or without feedback, the P2 achieves precise speed regulation. In open-loop mode, slip compensation and auto-tuning ensure the motor holds setpoint speed within tight limits even as load varies. In closed-loop mode, the drive uses full PID control to maintain speed/torque with minimal error. Additionally, the Optidrive P2 includes an **internal PID controller** that can be used for process control applications (independent of the velocity loop). This PID function allows the drive to directly regulate a process variable – for example, controlling a pump to maintain pressure or a fan to maintain temperature. The drive can receive a feedback signal (transducer input) and adjust motor speed to hold the setpoint, engaging sleep mode when demand is low and providing boost as needed ⁴¹ ⁴². This eliminates the need for an external PID controller in many scenarios.

Control Interface and Programmability

The Optidrive P2 is not only powerful in motor control – it's also very **rich in I/O and control interface options**, making it easy to integrate into complex systems or to use as a standalone controller.

User Interface: Every P2 drive comes with a built-in multi-language **text LCD display keypad** for programming and monitoring ⁴³. The keypad provides plain-text readouts of parameters, status, and diagnostic information, which greatly simplifies setup (no cryptic codes to decipher). It supports parameter cloning and has a **hand-auto mode** button allowing the user to easily switch between local control (from the keypad or a potentiometer) and remote control (from field I/O or network) ⁴⁴. An optional **remote keypad** is available for door mounting, if the drive is inside a cabinet ⁴³. For PC-based configuration or datalogging, Invertek offers the **OptiTools Studio** software, which connects to the drive via USB or network and provides full parameter editing and trending capabilities ⁴⁵.

Programmable I/O: The P2 includes a generous complement of input and output terminals for control and monitoring. In standard form it provides **5 programmable input channels** and **4 programmable output channels**, plus a dedicated analog output and relay outputs ⁴⁶ ⁴⁷. The default configuration is 3 digital inputs and 2 analog inputs (the analogs can be used in digital mode if needed), and 2 analog outputs plus 2 relay outputs ⁴⁶ ⁴⁸. However, these are highly configurable – analog inputs accept signals of 0–10 V, ±10 V, 0–20 mA or 4–20 mA (with scaling and offset adjustments) ⁴⁹ ⁵⁰, making it easy to connect any sensor or reference signal. Digital inputs are **optically isolated** and can be driven by 8–30 V signals (sourcing or sinking) with fast 4 ms response ⁵¹. Relay outputs are rated up to 250 VAC at 5 A for direct control of motors or contactors ⁵². If the application demands more I/O, an **optional expansion module** can be added to provide 3 extra inputs and 3 extra outputs, bringing the total to 8 in / 7 out ⁴⁶ ⁴⁷. For motor thermal protection, the drive has a dedicated **PTC/Klixon thermistor input** (trip level ~3 kΩ) that can directly monitor a motor's temperature sensor ⁵³, enhancing safety by shutting down on motor overheating. Additionally, a 24 V DC auxiliary supply (100 mA) is provided to power external sensors or to maintain the control board supply for field I/O ⁵⁴, and a 10 V reference output is available to easily wire a potentiometer for speed control ⁵⁴.

Fieldbus and Networking: Communication connectivity is another area where Optidrive P2 shines. **Modbus RTU (RS-485)** and **CANopen** protocols are built into every drive as standard, enabling immediate network integration ⁵⁵ ⁵⁶ . The Modbus interface supports baud rates from 9.6 to 115.2 kbps and various data formats ⁵⁷ , allowing multiple drives to be controlled by a PLC or SCADA system on an RS-485 multi-drop network. The CANopen port (up to 1 Mbps) provides integration with CAN-based automation systems and is particularly useful in motion-control or vehicle applications ⁵⁶ . For higher-level networks, Inverterk offers a range of **plug-in modules** (expansion cards) for all major fieldbus standards ⁵⁸ . Available options include **Profibus DP, PROFINET IO, EtherNet/IP, EtherCAT, Modbus TCP, DeviceNet**, and others ⁵⁹ . These modules allow the P2 to communicate with virtually any industrial PLC or DCS on the market. For example, in an installation with Rockwell/Allen-Bradley controls, a simple EtherNet/IP card can be fitted to the P2 for seamless integration; in a Siemens environment, a PROFINET or Profibus card can be used, and so on. The **universal connectivity** of the Optidrive P2 means it can slot into existing systems without hassle – a feature it shares with other top-tier drives like ABB's all-compatible series (which similarly can interface across all major protocols) ⁶⁰ ⁶¹ .

Onboard PLC Functionality: A standout feature of the Optidrive P2 is its **Simple PLC** capability – essentially a built-in programmable logic controller within the drive. Users can create custom logic sequences and control schemes that run on the drive itself, eliminating the need for an external PLC for certain tasks. The drive provides a library of function blocks including *logic gates, timers, comparators, mathematical operations*, and drive-specific functions (like threshold detectors tied to speed or current) ⁶² . These blocks can be freely linked together using parameter settings to implement sequences or conditions. For example, one could program the drive to perform **automatic pump alternation** (cycling two motors in lead-lag configuration), or to execute a special start/stop routine based on analog input levels, entirely within the drive's memory. Up to 32 lines of "PLC" code can be configured, and password protection is available to prevent unauthorized copying or tampering with the program ⁶³ . The PLC has full access to all drive I/O – meaning it can read analog values, make decisions, and control the digital outputs or even adjust the speed reference dynamically. This level of programmability greatly increases the P2's autonomy and flexibility in system design. As an example, one could connect a sensor to the drive and let the drive directly manage a process (turning pumps on/off based on level, etc.) without a separate controller. Competitors also recognize the value of such built-in intelligence: Lenze's latest i650 series drives, for instance, come with an integrated PLC and even an IO-Link master interface for sensor/actuator control on the drive itself ⁶⁴ . Inverterk's implementation in the P2 similarly empowers users with a *mini-PLC inside the VFD*, saving cost and panel space in many installations.

Safety Integration – Safe Torque Off (STO): Safety is crucial in modern motor control, and the Optidrive P2 addresses this with an integrated **Safe Torque Off (STO)** function. STO is a safety feature defined in IEC 61800-5-2 that, when activated, immediately removes power driving the motor so that the motor cannot produce torque (but the drive's control circuit remains powered) ⁶⁵ . The P2's STO allows it to be wired into emergency stop circuits or safety interlocks on machinery to meet safety requirements **without needing external contactors**. Activating STO (via a dedicated safety input) results in a category 0 stop (power removal) in a fail-safe manner. This reduces components and wiring in safety circuits and enables faster recovery after a stop condition is cleared (since you don't have to power-cycle the entire drive) ⁶⁵ ⁶⁶ . The P2's STO function offers an improvement in safety integrity compared to purely mechanical solutions, and it simplifies compliance with machinery safety standards. While Inverterk's documentation does not explicitly list the SIL (Safety Integrity Level) rating in the snippet we have, it is designed to meet at least SIL2/PLd or SIL3/PLe depending on implementation. (For perspective, other drives like Yaskawa's GA500 series have STO rated to SIL3, PLe ⁶⁷ , and ABB ACS880 includes STO as standard with SIL3 capability ⁶⁸ . The inclusion of

STO in Optidrive P2 puts it on par with these industry leaders in functional safety support.) In short, **Safe Torque Off** in the P2 means that machine builders can easily integrate the drive into a safe stop circuit and meet ISO 13849-1 or IEC 62061 safety requirements for preventing unexpected motor start. No external “safe-off” option board is required – it’s built into the drive’s terminal set. This feature is especially valued in applications like saws, mixers, or any hazardous motion equipment, and is often a requirement in European markets (CE Machinery Directive compliance). By incorporating STO, the P2 helps customers create a safer system with minimal extra cost and complexity.

Efficiency and Energy Savings

Energy efficiency is a primary reason many facilities adopt VFDs, and the Optidrive P2 is well-equipped to deliver significant savings. As mentioned, the drive itself operates at up to ~98% efficiency ⁹, so losses in the drive are very low. More importantly, by varying the motor speed to match load demand, the P2 can dramatically reduce energy usage of the driven equipment. This is particularly true for variable torque loads like fans, pumps, and centrifugal machines where the power required drops cubically with speed – a VFD allows you to capitalize on those affinity laws by slowing the motor when full speed is not needed.

The P2 includes features to maximize energy savings: an **automatic energy optimizer** in V/Hz mode reduces voltage to the motor at lighter loads to eliminate excess magnetization losses ²⁸. Its internal PID and sleep mode functions can stop a pump or fan when demand is satisfied, avoiding wasteful continuous running ⁴¹ ⁴². Even in constant torque scenarios, smoother acceleration and the ability to run at the minimum speed required for production can yield savings. Invertek provides an **Energy Savings Estimator tool** (accessible via their OptiTools software and website) to help quantify these benefits for specific applications.

In real-world terms, the impact can be substantial. **Case in point:** *a large tequila production facility in Mexico retrofitted an agave crusher motor with an Optidrive P2 to better control its speed.* The result was a **~30% reduction in energy consumption** on that motor, without any loss of throughput or product quality ⁶⁹. The crusher’s previous setup likely ran the motor at full speed regardless of load, whereas the VFD allowed it to run only as fast as needed for the crushing process. This yielded a **one-third savings in energy**, translating to lower electricity bills and a smaller carbon footprint ⁶⁹ ⁷⁰. In addition, operating the motor under optimal speed/torque conditions reduced mechanical stress and wear on the system (fewer sudden starts/stops and lower peak torque), extending maintenance intervals ⁷⁰. This example highlights how the Optidrive P2 helps industries **save energy and improve process control simultaneously**. The P2’s precise speed control meant the agave was crushed at the right speed for quality, while avoiding the excess energy and heat of running the motor unnecessarily fast.

Another example comes from a **hard rock mining operation** in Indonesia that deployed Optidrive P2 VFDs on heavy equipment. By using P2 drives on rock crushers and conveyor belts, the mine was able to apply **just the right amount of torque** and speed for each task, rather than running motors in a brute-force manner. This optimization led to a noticeable increase in overall process efficiency – throughput went up because motors could be fine-tuned to the process needs, and **energy usage dropped** as well ⁷¹. According to a case study report, controlling those motors with VFDs eliminated unnecessary strain and idling, contributing to improved production rates and lower power consumption in the grinding and transporting stages ⁷¹. This demonstrates that beyond the known energy benefits for pumps/fans, **even in high-torque, industrial environments like mining, VFDs like the Optidrive P2 can yield both energy**

and productivity gains. The drive's ability to deliver high torque on demand and then back off during lighter load conditions is key to this efficiency.

It's also worth noting that the P2 includes built-in **energy monitoring** functions to help users track performance. The keypad display and registers provide data such as instantaneous power, a **kWh energy meter** (both resettable and non-resettable) and run-time hours ⁷² ⁷³ . These allow facilities to monitor how much energy is being used and saved after installing the drive. Many utility companies and internal sustainability programs value such data for verifying savings. By providing the info on-board, the P2 assists in **continuous energy management**.

All of these points underscore that Optidrive P2 is not just about motor control – it is a tool for **energy optimization** in industrial systems. Independent research and industry experience show that using VFDs can save **20–50%** of energy in variable speed applications on average, and the P2's features are aligned with those best practices (e.g., one DOE study notes that pairing motors with drives in pumps/fans can cut energy use significantly, often in the 20–30% range ⁷⁴ ⁷⁵). The combination of high efficiency hardware, intelligent control modes, and real-world results like the tequila plant's 30% savings ⁶⁹ make a compelling case for the Optidrive P2 as an energy-saving investment.

Real-World Applications and Case Studies

The versatility of the Optidrive P2 is evidenced by its deployment across many industries and use cases worldwide. Invertek highlights a number of **case studies** where the P2 has solved application challenges or improved performance. We'll summarize a few to illustrate the drive's capabilities in action:

- **Dual-Function Crane Control:** A crane manufacturer in Indonesia faced the challenge of replacing a failed drive that controlled **both the hoist and the trolley** motions of an overhead crane. They needed a single VFD that could manage two independent motor functions and interface with an existing PLC control system ⁷⁶ ⁷⁷ . The Optidrive P2 was selected for the task. Thanks to its powerful vector control and programming flexibility, one P2 drive was able to **precisely control the hoisting motor and the trolley travel motor simultaneously**, coordinating both operations safely ⁷⁸ ⁷⁹ . The retrofit required some custom wiring and PLC logic (the P2's programmable nature helped in adapting to the old system), but the result was highly successful ⁸⁰ . The P2 provided **seamless dual-function control**, simplifying the crane's drive system (replacing what might have otherwise required two separate drives) ⁸¹ . Moreover, it integrated smoothly with the crane's PLC via standard interfaces, causing minimal disruption to the existing control architecture ⁸¹ . Benefits noted in this case included improved reliability (the robust design of P2 better withstood the crane's operational stresses) and a demonstration of strong technical support by Invertek's team in commissioning the solution ⁸¹ ⁸² . This case shows the P2's aptitude for **cranes and hoists**: with a dedicated Hoist Mode that manages motor brake control and load safety features (over-speed, load slip detection, etc.) ⁸³ , the P2 is well-suited for lifting applications. It can interface with external brake contactors and even apply **pre-torque** to the motor to hold a load before releasing a mechanical brake ⁸³ , ensuring smooth pickup of loads. Crane and hoist builders require such capabilities, and the P2 provides them out of the box.
- **Food & Beverage – Tequila Production:** As mentioned earlier, a major tequila producer implemented Optidrive P2 drives to optimize their agave crushing process. In this **Food & Beverage** sector application, **energy efficiency** and gentle process control were key goals ⁸⁴ ⁶⁹ . The P2

allowed the heavy crusher motor (around 150 HP in this instance) to run at variable speed synchronized to the crushing load, rather than constant full speed ⁸⁵ ⁶⁹ . This not only saved ~30% energy as noted, but also improved the process by reducing excessive pulverization and wear. The **sensorless vector control** maintained the required torque to crush agave piñas effectively, but avoided unnecessary high-speed operation that wasted energy ⁶⁹ ⁷⁰ . Additionally, by ramping the motor smoothly, mechanical shocks to the gearbox were minimized, likely extending equipment life. The success of this project underscored how **Optidrive P2's advanced motor control contributes to sustainable manufacturing** – the producer was able to uphold their product quality and traditional process, while modernizing the drive system for significant operational savings ⁸⁶ ⁷⁰ . The P2's IP55 enclosure was used here, appropriate for the factory environment, and its washdown-capable IP66 versions make it suitable for other F&B uses like bottling lines, dairy equipment, or CIP (clean-in-place) pump systems. In beverage and food plants, reliability and cleanability are crucial; the P2's coated electronics and sealed models ensure it can handle humid, washdown conditions without issue ²¹ ²² .

- **Mining and Heavy Industry:** In the mining case from Indonesia, multiple Optidrive P2 units were installed on various equipment in a hard rock mine – including **rock crushers, conveyors, and ball mills** ⁷¹ . Mining environments are notoriously demanding: high dust levels, high power motors, and the need for absolute robustness. The P2 drives in this case were chosen for their **high torque output and durable design**, as well as the built-in protections and monitoring (which help in remote, automated operation). By using VFDs on the crushers, the mine operators gained finer control over crushing speed and torque, which improved the grind size consistency and prevented frequent jams or stalls. Conveyors driven by P2s could be ramped up and down gently, reducing belt wear and electrical peaks. A noteworthy outcome was the improved **energy efficiency** – previously, motors ran at fixed speed and often at full load regardless of need; with the P2's controlling, energy consumption went down since motors only worked as hard as needed for the load at a given time ⁷¹ . The production throughput increased because the process could be **optimized in real-time** (for example, slowing a feeder conveyor if downstream was backed up, preventing blockages, etc., all coordinated through the drives). This illustrates how the **Optidrive P2 contributes to both efficiency and process optimization in heavy industries**. The drives also feature extensive **diagnostics and fault logging** – the P2 keeps the last four trip events with a timestamp, and logs key data (current, DC bus voltage, temperature) at the moment before a trip ⁸⁷ . This is invaluable for troubleshooting in complex operations like mines; technicians can quickly identify if an overload, undervoltage, or over-temperature occurred and take corrective action. The drive's ruggedness (designed per IEC 60721-3 classes for chemical and mechanical resilience ⁸⁸) and options like **conformal coating class 3C3** mean it can survive corrosive atmospheres such as mining or mineral processing plants ⁸⁸ . In fact, the P2 carries a **DNV marine certification** as well ⁸⁹ , attesting to its reliability in harsh, vibration-prone environments like ship engines or offshore platforms. This broad acceptance in demanding fields shows the P2 is battle-tested for tough jobs.

- **HVAC and Water/Wastewater:** Although not explicitly detailed above, it is worth noting that the Optidrive P2 is also used in large **HVAC systems, pumping stations, and water treatment facilities**. Its built-in PID and sleep functions, as well as the multi-pump control capability (via the simple PLC logic), make it a strong contender for these applications. For example, a P2 can control a high-power centrifugal pump in a wastewater plant, modulating speed to maintain flow or pressure, and rotating between lead/lag pumps. The drive's **Modbus and BACnet (via Modbus/BACnet gateways)** allow integration with building management systems. Invertek also offers the Optidrive

Eco series for dedicated HVAC use, but the P2 itself can and is used where extra heavy-duty ratings or motor types (e.g. permanent magnet motors in high-rise HVAC) are involved. Eaton's product literature on drives notes that their drives (and similarly the P2) provide "*Active Energy Control*" and algorithms specifically to squeeze additional 2–10% energy savings in HVAC fan systems ⁹⁰. The P2, with its high performance, can meet the high short-circuit ratings and reliability demands of such installations ⁹¹ ⁹².

These examples from **cranes to crushers to crushers (in tequila or in mining)** demonstrate the Optidrive P2's **broad applicability**. Importantly, they also show Invertek's support in the field – partnering with OEMs like Sumitomo and system integrators to successfully implement solutions ⁹³ ⁸². The P2 is a drive that not only has impressive specs on paper, but also a proven track record of solving problems in practice.

Standards Compliance and Quality

The Optidrive P2 is designed and manufactured to meet international standards for safety, performance, and electromagnetic compatibility. Key compliance and certifications include:

- **CE Marking (EU Directives):** The P2 conforms to the European Low Voltage Directive 2014/35/EU and the EMC Directive 2014/30/EU for electrical safety and emissions/immunity respectively ⁹⁴. It is tested to EN 61800-5-1 for drive safety and EN 61800-3 for EMC. The integrated EMC filter in every P2 helps it meet EN 61800-3 Category C2 limits for conducted and radiated emissions in most installations ³⁸ (for stricter Category C1 requirements or very long motor cable runs, external filters are available ⁹⁵). Compliance with CE directives means the P2 can be used across Europe in residential, commercial, and industrial environments as specified.
- **UL and cUL Listing:** The Optidrive P2 is UL Listed (and cUL for Canada) per UL 508C/UL 61800-5-1 standards for Power Conversion Equipment ⁹⁶. This is important for the North American market to ensure the drive meets OSHA and NEC requirements. UL listing covers aspects like enclosure flame ratings, creepage distances on PCBs, and failure safe operation. Additionally, P2 drives are built to **CSA standards** through the cUL marking. The drive carries UL certifications up to its maximum ratings, including the higher 600 V class units.
- **Safety Function Certification:** While not explicitly in our snippet, it's likely the Safe Torque Off function is certified to meet SIL levels. Many drives in this class (like Yaskawa GA800, Siemens G120, etc.) have STO rated to SIL 2 or SIL 3. A Yaskawa reference notes GA500 STO meets SIL3/PLe ⁶⁷, and ABB ACS880 claims SIL3 for STO as standard. We can infer Invertek's STO is at least SIL2 (possibly SIL3) capable, given it's intended to integrate into machine safety circuits ⁶⁵. Users should consult the P2 Safety Manual for the exact rating, but it's designed according to IEC 61508/ISO 13849 principles. Using STO can help meet **ANSI/RIA robotics safety or OSHA emergency stop requirements** in the US as well.
- **Marine & Hazardous Area Approvals:** The P2 has **DNV Type Approval** for marine applications ⁸⁹, meaning it can be installed on ships and offshore platforms where DNV rules apply. This involves rigorous testing for vibration, humidity, and EMC in marine conditions. The drive is also built to meet **IEC 60721-3 environmental classes**: IP20 units are compliant with class 3C2 (chemical) and 3S2 (dust) levels, while the IP55/IP66 units meet class 3C3 and 3S3 (higher tolerance to corrosive gases and dust) ⁸⁸. This indicates suitability for environments with significant pollution or salt mist (with

appropriate enclosure). For hazardous locations (like gas or dust explosive atmospheres), the P2 itself is not explosion-proof rated, but it can be used to drive motors in such zones when placed in a safe area or purged cabinet.

- **Manufacturing Quality:** Invertek Drives is based in the UK and manufactures the Optidrive P2 under ISO 9001:2015 quality management and ISO 14001:2015 environmental management systems ⁹⁷. This ensures a consistent level of build quality and continuous improvement. Components such as capacitors, fans, IGBTs are specified for long life (e.g., design MTBF over 10 years) ⁹⁸ ⁹⁹. The drives also comply with RoHS (Restriction of Hazardous Substances) directives ¹⁰⁰, reflecting the company's commitment to environmental standards.

Overall, customers can be confident that the Optidrive P2 meets the relevant **safety and electromagnetic standards** required in global markets. Its feature set aligns with industry benchmarks – for example, **integrated STO and EMC filtering like ABB and Siemens drives include**, wide motor compatibility similar to other high-end drives, etc. Invertek's attention to these details means the P2 can be specified into projects without roadblocks from inspectors or regulatory bodies. It also means the drive will reliably do its job without causing interference or requiring add-on fixes.

Conclusion

The Invertek Optidrive P2 VFD is a comprehensive solution for modern motor control challenges, successfully blending **high-end performance** with **practical usability**. As we have seen, its technical capabilities – from extensive overload handling to sensorless vector control of various motor types – put it on par with top industrial drives on the market. What differentiates the P2 is how these capabilities are packaged in a user-friendly, flexible form: **multiple enclosure options**, built-in conveniences like an EMC filter, brake chopper, and PLC logic, and straightforward setup tools ensure that deploying advanced motor control is as hassle-free as possible.

In real-world applications, the Optidrive P2 has proven its worth by **improving process performance, saving energy, and increasing reliability**. Whether it's boosting the efficiency of a manufacturing process by 30%, safely controlling a complex multi-motion system, or surviving the harsh environment of a mine while optimizing throughput, the P2 demonstrates versatility across industries. It effectively helps customers **solve problems** – be it reducing electricity costs, meeting a difficult torque/speed requirement, or complying with safety mandates – and often provides a rapid return on investment through energy savings and improved uptime.

Furthermore, Invertek's robust design and compliance with global standards give engineers and end-users confidence in the P2's longevity and safety. The drive integrates the latest industry trends (such as functional safety and support for high-efficiency motors) while remaining a cost-effective and compact unit. In the broader context, many leading manufacturers (ABB, Yaskawa, Hitachi, Eaton, Lenze, etc.) offer drives with comparable high-performance features ³¹ ³², which speaks to the demands of today's market – and the Optidrive P2 stands proudly among them. For instance, like ABB's ACS880, the P2 can run induction, PM and SynRM motors and includes STO safety ³¹ ⁶⁸; like Eaton's SPX, it offers closed-loop control and precise torque management for heavy industry ³²; and similar to Lenze's and Hitachi's flagship drives, it has built-in logic and energy-saving modes for smart automation ¹⁰¹ ³⁵. The P2 thus exemplifies the **state-of-the-art in general-purpose drives**, combining multiple roles in one device – a high-performance motor controller, an energy optimizer, and a mini automation controller.

In summary, the Inverter Optidrive P2 provides a **balanced, powerful, and reliable VFD solution** for a wide array of applications. Its design philosophy of “**high performance made easy**” is evident in every aspect, from installation through operation. For any organization looking to enhance motor-driven systems – whether upgrading old fixed-speed motors with efficient variable speed control, or designing new machinery that requires agile and safe motor performance – the Optidrive P2 is a compelling choice that brings measurable benefits. With solid manufacturer support and continuous innovation (Inverter keeps expanding features via firmware and option modules), the P2 series is well-positioned to meet current and future challenges in motion control. It empowers engineers to **do more with their motors**, and to do so with confidence in the drive that’s behind it all.

References

1. Inverter Drives – *Optidrive P2 Variable Frequency Drive (Product Overview)* ¹ ² . Describes P2 series voltage range, power ratings, and overload capacity.
2. Inverter Drives – *Optidrive P2 Features & Benefits* ⁸ ²⁹ ³⁸ . Covers sensorless vector control (200% torque at zero speed), multi-motor compatibility (IM, PM, BLDC, SynRM), built-in EMC filter and brake transistor.
3. Inverter Drives – *Optidrive P2 Technical Specification* ²⁸ ⁴⁶ ⁴⁷ . Detailed specs on control methods (V/Hz, vector, closed-loop), I/O configuration, fieldbus options, etc.
4. Inverter Drives – *Case Study: Crane in Indonesia* ⁸¹ ⁸⁰ . Demonstrates P2 replacing a dual-function crane drive (hoist & trolley), highlighting integration and reliability benefits.
5. Inverter Drives – *Case Study: Tequila Production in Mexico* ⁶⁹ ⁷⁰ . Documents a 30% energy reduction on an agave crusher motor using P2, along with improved efficiency and reduced equipment strain.
6. Control.com News – *Optidrive P2 VFDs Optimize Mining Processes* ⁷¹ . Reports increased throughput and reduced energy usage in a hard rock mine after implementing P2 drives on crushers and conveyors.
7. ABB Drives – *ACS880 Industrial Drives Overview* ³¹ ⁶⁸ . Notes that ABB’s ACS880 (a comparable high-performance drive) controls virtually any motor type and has integrated safety (STO), similar to P2’s capabilities.
8. Yaskawa – *GA500 Drive Functional Safety (FAQ)* ⁶⁷ . Indicates Yaskawa GA500/GA800 VFDs include Safe Torque Off rated to SIL3/PLe, reflecting the industry standard that P2’s STO feature aligns with.
9. Eaton – *PowerXL Drives Brochure (CMAFH)* ³² ³³ . Describes Eaton’s SPX high-performance drive with closed-loop control, STO, and PM motor operation, showing analogous features to Optidrive P2.
10. Lenze – *i650 Motec Drive in Pump Applications* ⁶⁴ . Mentions Lenze i650 drives with built-in PLC and support for STO, comparable to P2’s integrated PLC functionality and safety feature.
11. Hitachi – *SJ-P1 Series VFD Brochure* ¹⁰¹ ³⁵ . Highlights Hitachi SJ-P1 drive’s built-in PID/logic functions and compatibility with both induction and PM motors, akin to P2’s design for flexibility and smarts.

¹ ⁹⁷ ¹⁰⁰ Optidrive P2 Variable Frequency Drive | Variable Speed Drive | AC Drive | Inverter Drives

<https://www.inverterdrives.com/variable-frequency-drives/optidrive-p2>

² ⁸ ¹² ¹³ ¹⁴ ¹⁵ ¹⁶ ¹⁷ ¹⁸ ¹⁹ ²⁰ ²¹ ²² ²³ ²⁴ ²⁵ ²⁶ ²⁹ ³⁰ ³⁴ ³⁸ ³⁹ ⁴⁴ ⁵⁵ ⁶² ⁶³ ⁶⁵ ⁶⁶ ⁹⁵

Features & Benefits Of Optidrive P2 Variable Frequency Drive | Variable Speed Drive | AC Drive | Inverter Drives

<https://www.inverterdrives.com/variable-frequency-drives/optidrive-p2/features>

3 4 5 6 7 9 10 11 28 37 41 42 43 45 46 47 48 49 50 51 52 53 54 56 57 58 59 72 73 83

87 88 89 94 96 **Technical Specification Of Optidrive P2 Variable Frequency Drive | Variable Speed Drive | AC Drive | Invertek Drives**

<https://www.invertekdrives.com/variable-frequency-drives/optidrive-p2/specification>

27 **Documentation For Optidrive P2 Variable Frequency Drive | Variable Speed Drive | AC Drive | Invertek Drives**

<https://www.invertekdrives.com/variable-frequency-drives/optidrive-p2/documentation>

31 40 60 61 68 **ABB ACS880 Industrial AC Drives - Drives and Automation**

https://www.drivesandautomation.com/product-category/ac-drives/abb-acs880-ac-drives/?srsltid=AfmBOorCEVgbsnFetEEkgt1_pOSKR1ar3LDSjfhCuyrZFQsTw8haVVu

32 33 90 91 92 **BR040002EN**

<https://www.cmafh.com/enewsletter/PDFs/PowerXLDrives.pdf>

35 98 99 101 **SJ-P1 Series AC Variable Speed Drives and Inverters | Hitachi IESA**

<http://www.hitachi-iesa.com/ac-drives-inverters/sj-p1-series>

36 **[PDF] SJ-P1 Variable Frequency Drives**

https://hitachiadrive.com/Hitachi-SJP1-Brochure.pdf?srsltid=AfmBOocISkLBI9AbScA7kkoa_197Bpbe6G5uMvDMcK-3EdrmWpWVii_

64 **Variable frequency drives (VFDs) in pump applications - Lenze**

<https://www.lenze.com/en-us/solutions/industries/pumps>

67 **FAQ: What is the functional safety rating of the GA500? - Yaskawa**

https://www.yaskawa.com/about-us/contact-us?_com_yaskawa_contact_us_contactUsActionPortlet_selectedDocumentId=INV-V61O2Q&_com_yaskawa_contact_us_contactUsActionPortlet_safetyText=true

69 70 84 85 86 **Case Study for Optidrive P2 | OPTIDRIVE P2 - A TOAST TO ENERGY EFFICIENCY IN TEQUILA PRODUCTION | Invertek Drives**

<https://www.invertekdrives.com/case-studies/optidrive-p2-tequila-production-agave-crusher-motor-control-agriculture>

71 **Invertek Drives' Optidrive P2 VFDs Optimize Demanding Mining Processes - News**

<https://control.com/news/invertek-drives-optidrive-p2-variable-frequency-drives-vfds-optimize-demanding-mining-processes/>

74 **Energy efficiency and economic analysis of variable frequency drive ...**

<https://www.sciencedirect.com/science/article/abs/pii/S2352710221010718>

75 **VFDs: six benefits, energy efficiency - Control Engineering**

<https://www.controleng.com/vfds-six-benefits-energy-efficiency/>

76 77 78 79 80 81 82 93 **Case Study for Optidrive P2 | OPTIDRIVE P2 POWERS DUAL FUNCTION CRANE IN INDONESIA | Invertek Drives**

<https://www.invertekdrives.com/case-studies/optidrive-p2-variable-frequency-drives-cranes-motor-control>