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Hitachi SJ700B Variable Frequency Drives (VFDs)

Overview

The **Hitachi SJ700B Series** is a line of advanced industrial AC variable frequency drives that builds upon the performance of its predecessor (the Hitachi L700) with significant improvements in torque, control, and functionality. Introduced in late 2013, the SJ700B drives were designed to deliver **high torque at low speeds**, enhanced programmability, and broad application flexibility for industries ranging from pumps and fans to conveyors and cranes. Hitachi's upgraded sensorless vector control algorithm enables the SJ700B to achieve **150% of rated torque at 0.5 Hz** (and even maintain around **120% torque at 0 Hz** in a special "zero-speed domain" mode for holding loads) [1]. This means the drive can start and run heavy loads at very low speeds without stalling – a critical requirement for cranes, hoists, extruders, and other high-torque applications. The series also supports closed-loop vector control (with an optional encoder feedback module) for even more precise speed and position control when needed [2].

In addition to raw power, the SJ700B provides sophisticated **built-in control features**. Notably, Hitachi's **EzSQ ("Easy Sequence") programming** is integrated, essentially embedding a small PLC-like logic controller inside the drive [3]. This allows users to create custom control sequences and logic (via PC software) that run on the VFD itself – for example, regulating an irrigation pump system or executing a repeating motion profile – **eliminating the need for a separate PLC** in many cases [3]. The ability to program the drive's behavior internally not only simplifies system design but can also reduce cost and panel space. The SJ700B's emphasis on application integration reflects a broader industry trend: modern VFDs often include programmable logic and intelligence on-board (for example, Hitachi's earlier L700 series and competitors like ABB and Yaskawa offer similar internal programming or sequence control features) [4] [5]. This means the SJ700B is designed as a **one-stop solution** for complex drive applications, handling both motor control and basic logic tasks within a single unit.

From a design standpoint, the Hitachi SJ700B series is engineered for **industrial reliability and ease of use**. It expanded its operational ambient temperature range to -10 °C up to 45 °C without derating [6], indicating robust thermal management suited for harsh environments. All models in the series come with a **built-in EMC filter** to meet EMC compliance (EN61800-3 C3 for second environments) and reduce electromagnetic noise emissions [7]. For the end user, this means simpler installation and compliance with CE requirements since an external filter is not needed. Models up to 30 kW (approximately 40 HP) also include a **built-in dynamic braking transistor**, allowing for connection of a braking resistor to absorb regenerative energy [7]. This feature is important for high-inertia loads or rapid deceleration, and having it built-in (on smaller models) saves cost and panel space compared to adding an external braking unit. The SJ700B drives also incorporate Hitachi's patented **micro-surge voltage suppression** technology to protect motor windings from voltage spikes (reflected wave transients) that can occur with fast switching PWM drives [7]. This helps extend the life of the controlled motor, especially when retrofitting older motors or long cable runs, by mitigating insulation stress. In terms of standards and safety, the SJ700B is a globally rated product – it carries **UL and cUL listings, CE marking, c-Tick (Australia/NZ), and is RoHS compliant** for environmental directives [8]. Hitachi also notes that the drive includes conformance to relevant safety stop functions (the SJ700 series supports a "Safe Stop" function in accordance with EN 954-1 Category 3, an

earlier safety standard) [9], which can be used to integrate into emergency stop circuits (though it is not a full SIL-rated Safe Torque Off like some newer drives). Overall, the SJ700B's design philosophy is to deliver **high performance motor control** with **integrated features** for efficiency, **safety**, and **ease of integration**, making it a top-tier drive in its class during its era of introduction.

Key Features and Innovations

1. High Starting Torque & Advanced Motor Control: The flagship feature of the SJ700B is its ability to produce very high torque at low speeds using advanced **Sensorless Vector Control (SLV)**. Most models can achieve **150% torque at only 0.5 Hz output frequency** without any encoder feedback [1]. This is a remarkable capability – for context, 0.5 Hz corresponds to a motor running at just 1/120 of its base speed (for a 60 Hz motor, that's about 0.5% speed). Being able to generate 150% of rated torque at such a crawl ensures **smooth starting** and positive control of heavy loads like loaded conveyors, hoists, or mixers that need high breakaway torque. Hitachi also introduced an exclusive **"0 Hz Domain" control mode**, wherein the drive can hold approximately full torque at 0 Hz (zero speed) [1]. In practical terms, this means the SJ700B can apply **holding/stall torque** for applications that require maintaining tension or position at standstill (such as elevators holding a car, or extrusion machines maintaining screw torque before movement). This level of performance in open-loop control rivals that of closed-loop drives and approaches servo-like behavior. In fact, the SJ700B was marketed with a **simple position control capability**: by adding an optional encoder feedback board, the drive can execute positioning moves where the motor shaft moves from point A to B and then locks in position, functioning as a basic motion controller [10] [11]. While not a full servo system, this feature offered a cost-effective solution for applications needing moderate positioning accuracy (pick-and-place mechanisms, indexing tables, etc.) using a standard induction motor instead of a dedicated servo motor. Few general-purpose drives at the time offered this combination of **sensorless and optional sensored vector control** with actual position-loop features, which underscores the SJ700B's high-end motor control design.

It's worth noting that Hitachi's high-torque performance claims are in line with industry standards for premium VFDs – many general-purpose drives from top manufacturers can deliver on the order of **200% torque at low frequencies (~0.5–1 Hz)** with proper tuning [12]. The SJ700B keeps pace with these expectations, and its auto-tuning function helps optimize the vector control to the connected motor. Auto-tuning measures motor parameters (resistance, inductance, etc.) and adapts the control algorithm for maximum torque and stability. As a result, **speed regulation and torque production are very robust**, even as load conditions change. This gives the operator precise control over processes – for example, maintaining a constant tension in a winder or consistent speed on a heavily loaded conveyor. In **constant torque applications** like conveyors, mixers, and hoists, users can expect steady operation down to low speeds without the "cogging" or stall issues that simpler V/Hz drives might exhibit. And for **variable torque loads** (fans, pumps), the drive seamlessly handles speed adjustments while also offering energy optimization (more on that below). The combination of **V/Hz control (for simplicity), sensorless vector (for performance), and closed-loop vector (for highest precision)** in one unit makes the SJ700B highly versatile across different use-cases.

2. EzSQ Internal Programming (PLC Functionality): A standout innovation of the SJ700B series is the inclusion of **EzSQ (Easy Sequence) programmable logic** inside each drive. This is essentially a built-in mini-PLC that allows users to write custom programs (in a simple BASIC-like or flowchart language) and download them into the VFD's memory [3]. Once running, the drive can execute these logic sequences autonomously, based on its inputs, timers, and internal status, to perform control tasks **independently of**

any external controller. For example, one could program an SJ700B to run a **pump control routine** where it monitors an analog feedback for pressure and toggles between multiple setpoints or rotates between lead/lag pumps after certain hours – all without a separate PLC or smart relay. Another program might make the drive follow a specific speed profile (acceleration, run at certain speed, decel, repeat) for a repetitive motion in a manufacturing process. The **benefit** of EzSQ is a simpler system architecture and cost savings: for small systems, the VFD can handle both the motor driving and the automation logic. According to Hitachi, many applications can eliminate a standalone PLC by using the drive's internal sequencing for **logic decisions and control** [3]. This feature was first introduced in Hitachi's earlier SJ700 series and improved in the SJ700B, reflecting how drive manufacturers were adding more intelligence to drives. As noted in an industry overview by Precision Electric, several modern drives incorporate programmable logic or built-in PLC-style functions to handle **simple sequences or interlocks** without external controllers [13] – Hitachi's EzSQ is a prime example of this trend. The SJ700B's internal memory can store up to **1024 steps** of program instructions, and the programming software (EzSQ) is provided free of charge, making it accessible to engineers. Additionally, the drive has a **password protection** feature for the logic, to secure any custom code or prevent unauthorized tampering [14] [15]. In summary, EzSQ gives the SJ700B a high degree of flexibility and customizability on the fly. It's like having a drive and a basic PLC in one package – the drive can react to inputs (digital or analog), make decisions, and command its own speed or outputs accordingly. This is **especially useful in remote installations** or compact systems where adding a separate controller is impractical. Users have leveraged EzSQ for things like multi-pump alternation, simple pick-and-place machine sequences, timed batching operations, and more. By reducing the component count and wiring (since the logic is internal), reliability can also improve, and troubleshooting is centralized to the drive. The built-in programming is one of the SJ700B's key **value propositions** that sets it apart from lower-tier VFD models that only offer basic frequency control.

3. Trip Avoidance & Protection Features: The Hitachi SJ700B places strong emphasis on avoiding unnecessary downtime by intelligently handling abnormal conditions. One such feature is its **over-current and over-voltage suppression functions**. Thanks to an increased internal processing speed and refined algorithms, the SJ700B can actively monitor its output current and DC bus voltage and intervene to prevent trips [16]. During heavy acceleration or sudden load increases, the drive will momentarily modulate its output to prevent current spikes from exceeding the trip threshold ("over-current suppress"). Similarly, during rapid deceleration or when a load is driving the motor (regenerative condition), the drive engages a **DC bus AVR (Automatic Voltage Regulation)** function that automatically extends the decel time or otherwise dissipates energy to keep the DC bus voltage below the over-voltage trip level [17]. In effect, the drive **self-regulates to avoid nuisance tripping** in scenarios that would trip many conventional drives. For example, if a large fan is commanded to stop quickly, instead of tripping on over-voltage from regenerative energy, the SJ700B will temporarily lengthen the decel ramp to bleed off the energy safely [17]. These trip avoidance features are extremely valuable in maintaining process uptime – they allow the drive to "ride through" demanding events that used to cause shutdowns. The SJ700B also includes a patented **micro-surge voltage suppression** mentioned earlier, which protects the motor from voltage spikes. Together, these features contribute to what Hitachi calls "advanced trip avoidance functions" [7], meaning the drive is less likely to fault out in the middle of operation, thus improving **reliability** of the system.

On the protection front, the SJ700B provides a full suite of **fault monitoring and self-diagnostic features**. It continuously checks for conditions like output short circuits, ground faults, overheating, DC bus over-voltage or under-voltage, motor overload (thermal model), external fault inputs, CPU errors, memory errors, and more [18] [19]. If any unsafe condition is detected, the drive will fault and safely shut down output to protect the motor and itself. Notably, it has a **motor thermal overload protection** function (often

complying with IEC trip curves) to protect the motor from overheating due to heavy loads or slow cooling at low speeds. It can also interface with an external motor thermistor input for direct winding temperature feedback [20]. The SJ700B even supervises its analog input signals – for instance, if a 4-20 mA speed reference signal is lost, the drive can detect this and react (e.g. fault out or go to preset speed) to avoid running uncontrolled [21]. For preventive maintenance, the drive is designed with a **10-year maintenance interval** on critical components (cooling fans and DC bus capacitors) under normal operating conditions [22] [14]. It also has an **end-of-life warning** function that can notify the user when the cooling fan or capacitors are approaching the end of their design life [22]. This allows for scheduled maintenance rather than unexpected failures. In essence, the SJ700B's protective features ensure safe operation and **minimal downtime**, aligning with best practices in industrial maintenance.

4. Ease of Use and Integration: Despite its technical sophistication, the SJ700B was built to be **user-friendly in setup and daily operation**. The drive comes standard with a removable keypad/operator interface that has a multi-line display. Users can navigate parameters easily, and the SJ700B provides features like **user-customizable displays and parameter groups**. For example, there is a "user parameter" mode where only user-selected parameters (up to 12) are shown for simplicity, and a "basic parameter" mode that limits to the most commonly adjusted settings [14] [23]. This helps streamline commissioning by hiding advanced parameters when not needed, reducing the chance of confusion. Additionally, the keypad features a **copy function** – parameters can be uploaded from one drive and downloaded to another, which is invaluable when configuring multiple drives with the same settings. For larger programming or monitoring tasks, Hitachi provides the **ProDriveNext** PC-based software (via RS-485 or USB/serial connection) that allows full drive configuration, parameter editing, real-time monitoring, and data logging on a computer [24]. Many technicians prefer using the PC software for tuning the drive's performance (like auto-tuning the motor or adjusting gains in vector mode) as it provides graphical tools and the ability to save/print parameter sets.

Integration into automation systems is also straightforward. The SJ700B includes **Modbus/RTU communication** over RS-485 as a standard feature [25] [26]. This means out-of-the-box the drive can be networked and controlled or monitored by any Modbus master (such as an HMI or SCADA system, or a Modbus PLC). In many industrial facilities, having a common network protocol allows centralized supervision of all drives (reading speeds, currents, alarms) and remote adjustments. For users requiring other industrial fieldbus networks, Hitachi offered optional communication modules to interface with protocols like **EtherNet/IP, DeviceNet, Profibus-DP, PROFINET, CANOpen, and LonWorks** [27]. By installing the appropriate option board, an SJ700B drive can seamlessly join a higher-level network. This flexibility ensures that the drive can integrate into **modern IIoT and Industry 4.0 environments**, where connectivity and data are key. It's also compatible with remote I/O and sensor networks for feeding back signals. Furthermore, the SJ700B's digital inputs can be configured as either sink or source logic with a parameter change [7], so it adapts to the plant's wiring standards (PNP or NPN style) without needing external relays or special wiring – a small but convenient feature for installers.

Another aspect of ease-of-use is **maintenance and hardware design**. Hitachi designed the SJ700B for quick servicing – for example, the cooling fan assembly is easily removable so that fans can be replaced in minutes without dismantling the whole drive. The DC bus capacitors are also accessible for replacement with minimal disassembly. Moreover, the control terminals (for wiring inputs/outputs) are on a **removable plug-in terminal block**, meaning if a drive needs replacement, the wiring harness can be unplugged en masse and moved to the new unit without re-terminating each wire. This "drop-in replacement" capability is a time-saver and reduces downtime during drive change-outs (Hitachi even advertises the SJ700B as a direct

drop-in upgrade for older models like the L700 and L300P in many cases [27]). The mechanical form factor of the drive and mounting dimensions were kept similar to previous generations to aid retrofits. Additionally, **NEMA 1 conduit box kits** were available (optional) for models that required them, allowing proper conduit wiring and dust protection for installation in industrial panels [28]. All these details highlight Hitachi's focus on making the **installation, commissioning, and maintenance** of the SJ700B as smooth as possible. Users and integrators have generally found that once auto-tuned, the drives perform reliably with minimal tweaking, and the intuitive keypad/PC software lowers the barrier to accessing the drive's advanced functions.

5. Energy Efficiency and Special Functions: While the primary job of a VFD like the SJ700B is to vary speed, it also brings significant energy-saving opportunities and smart functions to optimize efficiency. The SJ700B includes an **automatic energy-saving mode** specifically useful for variable torque applications such as fans and pumps [29] [30]. In such modes, the drive can adjust the motor's voltage/frequency relationship in real-time to improve efficiency at partial loads – essentially supplying just enough energy to meet the demand. For example, at lighter loads the drive will reduce motor flux (voltage) to cut down on magnetization losses, which translates to lower power consumption and reduced heating. This function can yield noticeable energy savings in HVAC systems, chillers, water pumping stations, and other systems where the load often operates below full capacity. The principle is based on the affinity laws and the fact that reducing speed (even modestly) can dramatically cut power usage of pumps and fans (power scales roughly with the cube of speed). A **case in point**: In one analysis, running a 100 HP centrifugal pump at 60% speed (using a VFD) instead of full speed with throttling cut the annual energy cost from about \$27,000 down to \$6,000 – a **savings of over \$21,000 per year on that single motor** [31] [32]. This is because the pump only needed ~22% of full power at the reduced speed to meet the flow requirement, whereas the old method wasted energy across a throttling valve. This kind of drastic reduction showcases why adding VFDs is a go-to efficiency measure for industries and municipalities. The Hitachi SJ700B, with its advanced control, allows fine-tuning of speed to match demand, and the energy-saving mode further **optimizes motor magnetization**, making sure you're not drawing more kW than necessary at any operating point. Hitachi's documentation notes that users can expect substantial energy savings (30–50% or more in many cases) by applying variable-frequency drives like the SJ700B on fan and pump systems [33] [34] – in fact, major drive manufacturers such as ABB have published case studies (e.g. using an ACS580 drive) showing nearly 50% energy reduction in pump applications along with extended equipment life due to gentler operation [34]. The SJ700B fits right into this narrative by providing not only the speed control to leverage these savings but also built-in algorithms to maximize efficiency automatically.

Beyond energy efficiency, the SJ700B also includes features like a built-in **PID control loop** that can be used for process control tasks. This means the drive can directly maintain a setpoint (pressure, flow, temperature, etc.) by adjusting motor speed, using a feedback signal from a transducer. The integrated PID controller simplifies setups such as pump pressure regulation or airflow control, as it negates the need for an external PID controller. The drive's logic will increase or decrease speed to minimize the error between the process variable and the target setpoint. Many users employ this for **closed-loop control of pumps and fans**, keeping conditions constant even as loads vary. The SJ700B's PID function works in tandem with features like "sleep" and "wake" (to stop the motor when demand is zero and restart on rise in demand) and the energy-saving mode mentioned earlier, providing a comprehensive solution for **automating fluid system control**.

On the **power quality** side, Hitachi provides or recommends options for managing harmonics and interference. While the SJ700B has an internal EMC filter (for radio-frequency noise), large drives can

introduce harmonic distortion on the supply. For higher kW models, DC link chokes (reactors) are often included or provided to mitigate input current harmonics (reducing THD) and to comply with standards like IEEE 519 for harmonic limits [35] [36]. In fact, Hitachi's documentation for very large SJ700B units (above certain kW) advises using an external or included DC reactor to reduce harmonic current draw and protect the drive's capacitors [37] [38]. This ensures the drive can be used in environments with strict power quality requirements. Additionally, the SJ700B has **configurable carrier frequency (switching frequency) up to 12 kHz or 15 kHz** (depending on model size) [39] [30], which allows the user to trade off audible noise vs. efficiency. A higher carrier frequency can reduce motor noise and provide smoother current waveform, but at the expense of slightly higher losses in the drive. Operators can choose the optimal setting for their situation – for instance, using a high 10–15 kHz in a lab or commercial building for quiet operation, or a lower 2–4 kHz in a heavy industrial setting where efficiency and cooler drive operation are more important than noise. The drive will automatically down-rate or suggest max carrier frequency based on model (larger drives may limit to lower kHz due to heat).

Technical Specifications

The Hitachi SJ700B series spans a **wide range of power ratings and voltages** to accommodate different motor sizes. **Two primary voltage classes** are available: a 200–240 VAC class (for use on nominal 208–230 V three-phase supply) and a 380–480 VAC class (for nominal 460 V three-phase). Across these classes, the series covers motors from fractional kilowatt ratings up to well into the hundreds of horsepower. In the 230 V class, SJ700B models range roughly from **0.4 kW (1/2 HP)** up to around **75 kW (~100 HP)**, while the 480 V class models cover approximately **7.5 kW (10 HP) through 160 kW (215 HP)** in standard offerings [40] [41]. (Hitachi documentation indicates model codes up to "1600H" which corresponds to 160 kW; in some regions special models or variants may have extended into the 400 kW range for particular applications, but generally 160 kW was the high end for the SJ700B series in the mainstream catalog [42].) This broad sizing means the SJ700B can be used for anything from a small 1/2 HP machine drive all the way to large motors driving industrial compressors or large pumps. All models are **three-phase input and three-phase output**, and they can control standard induction motors (and even some permanent magnet synchronous motors in open-loop mode, according to Hitachi's notes). The output frequency range is **0.1 Hz up to 400 Hz** [43] [44], allowing for a wide speed range including overspeeding motors if required (many VFDs permit 2x base speed or more as long as the motor is capable). The SJ700B uses **pulse-width modulation (PWM)** with insulated-gate bipolar transistors (IGBTs) to synthesize the AC output, and the **carrier frequency** is adjustable from around 0.5 kHz up to 12–15 kHz max [45]. Lower carrier frequencies are used on larger horsepower units to manage heat, whereas smaller drives can be pushed to higher switching frequencies for quieter operation.

Typical **overload capacity** for the SJ700B drives is **150% of rated current for 60 seconds** (which corresponds to a "Heavy Duty" or constant-torque rating), or in some cases 120% for 60 seconds on the same drive if applied in a lighter duty (variable torque) scenario [46] [47]. Hitachi often provides dual ratings: one for constant torque (CT) applications and one for variable torque (VT) applications. For example, a drive might be labeled as 50 HP CT / 60 HP VT – meaning it can handle a 50 HP motor in constant torque use (with 150% overload) or a 60 HP motor in a pump/fan use (with 120% overload since those loads are easier). The selection of motor capacity vs. overload can be made by parameter setting (the SJ700B lets you choose VT or CT mode which adjusts trip curves) or simply by ensuring you size the drive appropriately. According to one distributor's data, for models up to around 22 kW (30 HP) the SJ700B provides the full 150% overload, whereas some of the higher kW models above ~75 kW may be limited to 120% overload continuous due to thermal constraints [48] [49]. Regardless, all drives can handle higher surge currents (200% or more) for very

short durations (a few seconds) for heavy startup conditions. **Duty cycle** capabilities such as 150% for 1 min, 180% for 0.5 sec, etc., are detailed in the manual – indicating these drives are truly heavy-duty rated for industrial service.

Input Specifications: The SJ700B accepts three-phase AC input in the stated voltage classes (230 V or 460 V nominal, with typical ±10% voltage tolerance). Input frequency can be 50 Hz or 60 Hz ±5%. All SJ700B drives are equipped with pre-charge circuits to limit inrush current on power-up, and most have built-in or included DC link reactors especially on the larger models to smooth the current draw. Users should ensure proper sizing of upstream protection; Hitachi provides recommended fuse or circuit breaker sizes for each model. For example, a 125 HP (90 kW) SJ700B-900H unit has a rated input current of about 154 A at 480 V, and might recommend a ~225 A fuse [50]. The efficiency of the drive itself is high (around 97–98% at full load is typical), and true power factor is about 0.95 due to the diode front-end.

Output and Control: The drive's output is adjustable from 0 Hz up to 400 Hz as noted, and the **voltage output is proportional to the input (max output ~ input voltage)**. It can provide full-rated torque down to low speeds in vector mode. The SJ700B supports multiple **control schemes**: it can run in the basic **V/f (volts-per-hertz)** mode (with either constant torque or variable torque V/Hz patterns, and even an adjustable V/Hz pattern for specialized loads) [51]. It can run in **Sensorless Vector** mode for high torque and speed precision. And with the optional encoder board, it can run in full **closed-loop vector control** (sometimes called flux vector or "vector with sensor") for applications requiring tight speed regulation or position control [2]. There is also a torque control mode available – by programming the drive in sensorless vector and using a torque limit function, one can make the drive regulate output torque (useful in winding or tensioning applications). In terms of **I/O (inputs/outputs)**, the SJ700B is well equipped: it typically provides **8 digital inputs** (configurable, 24 V logic) including one that can function as a high-speed pulse train input, and these inputs can be set to either sink or source configuration [7]. There are **5 digital outputs** (open-collector transistor type) and **1 Form-C relay output** for signaling drive status or faults [52]. For analog control, most models have **3 analog inputs** (one dedicated 0–10 V, one ±10 V, and one 4–20 mA) and **2 analog outputs** (one 0–10 V, one 4–20 mA) that can be scaled to represent any monitored parameter (speed, current, torque, etc.) [53] [54]. There is also a dedicated input for a motor thermistor (PTC) and an input for an external fault (USP) or safety interlock. The RS-485 serial port on the drive enables connection to networks or a PC. It communicates via **Modbus RTU protocol** at up to 115.2 kbps [55] [56], allowing fairly fast data exchange and command response.

From a physical standpoint, the **enclosure ratings** for standard SJ700B drives are IP20 (open chassis for panel mounting) on most sizes. Smaller units could be ordered with a NEMA 1 kit (adding a top cover and conduit box to meet UL Type 1). The larger models (above ~90 kW) often ship as IP00 (basic chassis) to be built into cabinets with appropriate enclosures or added fusing. The drive dimensions and weight scale up with power: for example, a 15 kW (20 HP) unit measures about 210 × 260 × 170 mm and weighs ~6 kg [57], whereas the 132 kW (175 HP) unit is around 480 × 740 × 270 mm and weighs ~70 kg [42]. All models include cooling fans (force-air cooled heatsinks), and as mentioned, those fans are replaceable. The mounting is typically vertical with clearance for airflow. Ambient conditions for operation are -10 °C to 50 °C (some models allow up to 50 °C with derating or 40 °C at full load; the press release noted 45 °C without derate as a new improvement [6]), and up to 1000 m altitude without derating (above 1000 m, cooling is less effective so derate or larger model selection is needed) [58]. The drives are designed for 20–90% non-condensing humidity and to be used in environments free of corrosive gases or excessive dust. For harsher environments (high dust or moisture), the SJ700B would need to be in an enclosure (NEMA 12, NEMA 3R, etc., depending on situation).

To summarize the spec profile: **Hitachi's SJ700B** is a heavy-duty, **general-purpose VFD** that covers roughly **1/2 HP through 200+ HP**, with input voltage options for both low voltage (208–240 V) and medium voltage (380–480 V) AC systems. It offers **multiple control modes (V/Hz, open-loop vector, closed-loop vector)**, a wide frequency range, and ample I/O for most standalone control needs. Its **overload capacity and thermal ratings** make it suitable for demanding industrial applications. When selecting a drive from this series, one would match the motor's voltage and horsepower and choose a model that either equals or exceeds the motor demands depending on duty. The SJ700B series was often praised for packing high-end features (normally found in premium "vector drives") into a relatively compact form factor and offering them at a competitive price point, making it a popular choice for both upgrades and new installations in the mid-2010s.

Real-World Applications and Benefits

Because of its versatile feature set and robust performance, the Hitachi SJ700B VFD found use in a **wide array of applications** across industries. Its ability to deliver high starting torque at low speeds made it ideal for **cranes, hoists, and elevators**, where heavy loads must be lifted from standstill smoothly. For example, in a crane application, the SJ700B's 0 Hz holding torque capability could keep a suspended load stationary without a mechanical brake momentarily, and the 150% torque at 0.5 Hz ensures a quick, strong lift when starting the hoist motor [1]. Likewise, **material handling systems** (conveyors in mining or manufacturing plants) benefited from the drive's sensorless vector control – providing tight speed regulation and fast acceleration to maintain throughput even as loading changes. One Midwestern grain facility, for instance, reported that upgrading older conveyor drives to modern VFDs (in their case Eaton/PowerXL drives) cut energy use by over 40% and avoided the need for a utility service upgrade [59] [60], illustrating how swapping in drives like the SJ700B can both save energy and improve system capacity. While that particular example was with another brand, the **outcomes are comparable**, as the Hitachi SJ700B offers similar efficiency gains and performance improvements. In **manufacturing processes** such as plastics extrusion and textile mills, the SJ700B's combination of torque control and built-in PID was valuable. A plastics plant could use the drive's PID to maintain extruder pressure or tension without external controllers, while the high torque at low RPM meant they could run an extruder screw slowly for certain products without stalling, improving product quality and reducing scrap. Similarly, a winder in textiles or paper could use the **torque control mode** to maintain tension as the roll diameter changes – the SJ700B's ability to do simple position or homing moves (with an encoder) might also be used to index material or control a dancer arm position.

The SJ700B also excels in **pump and fan systems**, which are extremely common in industries like HVAC, water treatment, irrigation, and building automation. By replacing on/off or throttle-valve control with VFDs, enormous energy savings can be realized, as described earlier. Hitachi actually cited applications like **irrigation pump control** as a perfect fit for the SJ700B – one can imagine a scenario where multiple pumps are controlled via one drive's logic: alternating duty cycles, ramping speed up and down based on soil moisture feedback, etc., all coordinated by the EzSQ program inside the drive [3]. In **municipal water and wastewater facilities**, reliability and easy integration are key; the SJ700B's network communication and self-diagnostics ensure it can be tied into SCADA systems for remote monitoring. Additionally, features like the energy-saving mode and sleep function mean that a water pump will only run as much as needed to maintain pressure, automatically idling when demand is low, thereby saving wear and tear on the pump and motor. Over time, this **extends the life of mechanical components** – for example, ABB reported that using a VFD to soften pump operation extended the pump seal life by two years in one case [34] (less pressure surges and heat). The SJ700B similarly would reduce mechanical stresses: its smooth acceleration and deceleration (with over-voltage suppress to avoid hard stops) prevent water hammer in pipelines and

reduce strain on belts and gearboxes in fan systems. Many building HVAC systems that retrofitted VFDs have seen **30–50% drops in energy consumption** and lower maintenance costs [33] [61]. The SJ700B's contribution to such scenarios is a combination of **efficient motor control** and **smart features** (like PID and schedules) that optimize the operation.

Another domain of application is **OEM machinery and automation equipment**. Machine builders who produce, say, packaging machines or food processing equipment, found the SJ700B attractive because they could use the drive's PLC functions to handle small machine sequences. For instance, a **bottling line** could use an SJ700B to ramp conveyors in coordination with filler operation, using digital I/O between the drive and sensors to manage bottle flow – all programmed via EzSQ inside the drive. This reduces the need for additional control hardware on the machine. Hitachi drives have been used in **mixers, grinders, and industrial washers** as well, where the **ruggedness** (10-year design life, robust protection) is crucial due to heavy usage. Users have reported improved process consistency because the drive can maintain speed under load better than older drive models; one paper mill that replaced older drives with new ones (similar class to SJ700B) saw unplanned drive failures drop by 76% and far more stable operation [62] [63], demonstrating the reliability gains of modern VFD technology.

From an **operational cost and ROI perspective**, the SJ700B (like other quality VFDs) often pays for itself quickly. Energy savings, reduced downtime, longer equipment life, and the ability to fine-tune processes all contribute to a strong return on investment. As an example, simply preventing trips during deceleration or overload (thanks to trip avoidance features) might save hours of downtime that would have occurred with a less sophisticated drive. If a single avoided production outage is worth thousands of dollars, the drive effectively **"earns" its cost back**. Many facilities also keep **spare drives** on hand due to the critical role they play – the SJ700B's easy parameter copy and drop-in wiring mean a spare can be swapped in within minutes in case of a failure, drastically minimizing production loss. (One anecdote from a beverage plant described how having a pre-programmed spare VFD on the shelf averted what could have been \$40k in downtime when a drive failed, by enabling a swap in under 10 minutes [64] [65].) Hitachi's focus on compatibility (with older models and standard interfaces) suggests that they understand the importance of quick replacement and support in industrial settings.

In summary, the **Hitachi SJ700B VFD** finds use in **virtually any AC motor-driven system** that can benefit from variable speed control, improved torque performance, or on-board intelligence. Its features make it particularly advantageous in high-torque low-speed scenarios (cranes, extruders), energy-sensitive flow control (HVAC, pumping), multi-motor coordination or standalone machine control (packaging, textile, printing), and high-reliability environments (continuous process industries). The drive stands out in its class for combining heavy-duty performance with advanced control functions. Whether the goal is to **save energy, increase production precision, reduce mechanical wear, or implement custom control logic**, the SJ700B provides a robust platform to achieve it. Users from different sectors have leveraged these drives to solve problems like **unstable conveyor speeds, frequent motor overheating, inefficient throttling systems, and even the lack of PLC capacity** – simply by installing an SJ700B and tapping into its capabilities. The broad compatibility with industry standards (from networking to safety and EMC) further ensures that it can be integrated into existing systems without hassle.

Conclusion

The Hitachi SJ700B series exemplifies a **high-performance, feature-rich VFD** that was ahead of its time in the mid-2010s and remains relevant for many industrial applications today. It brought together **powerful**

motor control (sensorless vector with near-servo torque and optional full vector), **user programmability** (built-in PLC features), and a suite of **practical enhancements** (trip avoidance, motor protection, energy saving, easy maintenance) in one package. This drive effectively bridged the gap between general-purpose drives and specialized servo or PLC-controlled systems, giving users an **all-in-one solution** for complex drive requirements. Because it was designed as a drop-in successor to previous Hitachi models, it also provided a smooth migration path for plants looking to upgrade aging drive units to modern technology with minimal re-engineering.

From an ROI and usability standpoint, the SJ700B has proven to deliver **significant benefits**: energy cost reductions, improved process control, and high reliability/uptime. Its adoption across different industries and the positive outcomes reported (such as energy savings of 30–50% in fan/pump systems [66] [67], or major reductions in downtime with newer drive systems [62]) underscore the impact that a well-chosen VFD can have. Even within a competitive market – where brands like ABB, Siemens, Yaskawa, Rockwell, and others all offer capable drives – the Hitachi SJ700B carved out a strong reputation. It provided all the essential features expected in a premium drive (and then some unique ones like EzSQ) while maintaining an accessible interface and robust build.

Although the SJ700B series is now considered a **legacy product** (it has since been succeeded by newer Hitachi drive families such as the Hitachi NE-S1 for micro drives and the next-generation series like the Hitachi WJ200 and **P1** series for high-performance needs), it remains in operation in many facilities and is supported for maintenance and retrofits. Precision Electric and other drive specialists continue to service SJ700B units, and in many cases can offer direct replacements or repairs to extend the life of installed bases. Newer drives might offer incremental improvements (like even higher efficiencies, integrated safety STO, or IoT connectivity), but the SJ700B's core capabilities are still very much aligned with the needs of most motor control applications. For any engineer or technician dealing with motor control challenges – whether it's getting more torque at low speed, simplifying control circuits, or slashing energy waste – the Hitachi SJ700B is a **proven solution** worth considering. It encapsulates the idea that a VFD is not just a speed controller, but a **key element of industrial automation** that can smartly adapt motor behavior to achieve better performance and efficiency. The SJ700B demonstrates how investing in a high-quality drive yields returns in both the short term (quick wins like energy savings) and the long term (enhanced reliability and process optimization).

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