ABB PSR Softstarters: Compact Motor Starting Solutions

Introduction

ABB's PSR series softstarters are a **compact and reliable solution** for controlling the startup and slowdown of AC motors. Softstarters are electronic starters that ramp up motor voltage gradually, reducing the inrush current and mechanical shock associated with direct-on-line (DOL) starters [1] [2]. By utilizing basic soft start and soft stop features, the PSR softstarter provides a gentle motor acceleration and deceleration, which **minimizes electrical surges and mechanical stresses** on the system. According to ABB, the PSR range is "a simple yet reliable starting solution" that performs especially well in applications requiring many starts per hour and in space-constrained installations [3]. In other words, it is **designed for frequent-start applications** and tight panels where traditional starters (like star-delta starters) might not fit or perform as well.

Motor softstarters such as the ABB PSR help **extend the lifespan of motors and connected equipment** by smoothing out startup torque and limiting peak currents [4]. An independent engineering study comparing DOL vs. soft starter methods found that using a softstarter yields a more controlled and faster startup, reducing transient currents and mechanical wear in systems like conveyors, pumps, and compressors [5] [6]. These benefits make softstarters widely popular in industry – from HVAC fans and pumps to industrial conveyors – wherever a gentler motor start can **improve reliability and reduce downtime** [7] [8]. The ABB PSR series in particular stands out for packaging these advantages into one of the **most compact softstarter designs** in the market [9].

Key Features and Benefits

The ABB PSR softstarter delivers core soft start/stop functionality with a focus on simplicity, robustness, and efficiency. Below are some of its **key features and benefits** that help solve common motor starting challenges:

- **Compact Size and Easy Installation:** The PSR is the smallest of ABB's softstarter ranges, making it possible to design very compact starting panels [9]. Its **footprint is comparable to a DOL starter** of equivalent rating, yet it provides the added benefits of soft starting and stopping [10]. Models up to 45 A are designed for convenient DIN-rail mounting in addition to screw mounting, which simplifies installation and saves space in control cabinets [11]. This compact design is ideal for OEMs and panel builders facing tight space requirements.

- **Many Starts per Hour (High Cycling Capacity):** A notable strength of the PSR series is its ability to handle **frequent start-stop cycles**. In standard operation, a PSR softstarter can perform **up to 10 starts per hour** at full load, and with an optional cooling fan accessory this doubles to **20 starts per hour** [12]. ABB also specifies that the PSR is **electrically robust**, capable of withstanding up to *100*

starts per hour under light load conditions or with appropriate de-rating [13] [14]. This high cycling capacity makes the PSR suitable for applications like packaging machines, intermittent conveyors, or repeated pumping cycles, where motors may be started and stopped very frequently.

- **Built-in Bypass for Energy Efficiency:** Once the motor reaches full speed, the PSR's design **automatically bypasses the internal thyristors** by closing an internal bypass contactor. This significantly reduces heat dissipation and electrical losses during run at full voltage [15] [16]. The built-in bypass not only improves efficiency and saves energy, but also **simplifies wiring** and cooling requirements compared to softstarters without an internal bypass. It eliminates the need to add an external bypass contactor, saving cost and panel space while improving reliability (the bypass mechanism is fully tested and integrated by ABB).

- **Simple Setup and Minimal Adjustments:** The PSR softstarter is intentionally kept **easy to configure**, even for non-experts. It features just **three front-panel potentiometers** for all adjustments [17]. These knobs set the **start ramp time** (adjustable 1 to 20 seconds), **stop ramp time** (0 to 20 seconds), and the **initial voltage level** (40–70% of nominal voltage) [18]. No complex programming or keypad is required – installation and setup of a PSR is as straightforward as a DOL starter [19]. This means quicker commissioning and less chance of configuration error. Despite its simplicity, the ramp profiles are optimized to ensure a **smooth acceleration and deceleration** for the motor in most general-purpose applications [20].

- **Reduced Mechanical and Electrical Stress:** By gradually ramping voltage, the PSR dramatically **limits the inrush current** and starting torque that a motor sees. Instead of the typical 6–8× full-load current surge with across-the-line starting, a properly set softstarter can limit the peak current to around 3–4× the motor's rated current [21]. This soft limiting of current and torque **prevents the sharp mechanical shocks** to belts, gearboxes, couplings, and driven machinery that DOL starters or even star-delta starters can cause [4]. The result is less wear on mechanical components (e.g. less belt slippage and stretch, fewer gearbox stresses) and reduced electrical stress on the motor windings and power supply. For example, pump and pipeline systems benefit greatly – the soft stop function can **eliminate water-hammer surges** by avoiding sudden stops, thereby protecting pipes and valves from pressure spikes [22]. Overall, using the PSR helps **increase uptime and extend equipment life**, as the motor and machine are not subjected to abrupt jolts during start or stop.

- **Integrated Motor Starter Solution:** The PSR series is often used in tandem with ABB's manual motor protectors (motor starter breakers) to form a complete motor starting and protection package. When paired with an ABB manual motor starter (MMS), the PSR softstarter can provide a full starter solution that includes **overload and short-circuit protection** in addition to soft start/stop control [23]. ABB specifically designed the PSR to coordinate with their MMS range, resulting in a very compact combination starter without the need for a separate overload relay. This simplifies panel design and ensures the motor is fully protected (since the PSR itself does not incorporate electronic motor overload protection). The PSR also includes **status indication LEDs** (for "On/Ready" and "Run/Top of Ramp" status) and offers output signal relays on larger models (PSR25 and above) to interface with external control or indicator circuits [24]. These features make it easier to integrate the softstarter into automation systems and provide feedback that the motor has successfully started or stopped.

- **Global Standards Compliance:** ABB's PSR softstarters are designed to meet international standards and certifications for motor control devices. They carry CE marking and cULus listing, and comply with IEC/EN 60947-4-2 (the standard for AC semiconductor motor controllers and starters) as well as UL 508 and CSA C22.2 No.14 for industrial control equipment [25] [26]. The devices are rated for operation up to 600 VAC and include variants for common control voltages (24 V AC/DC control or 100–240 V AC control) to suit global control circuit norms [27]. With an operating temperature range from **–25°C to +60°C** (−13°F to 140°F) and altitude capability up to 4,000 m with derating [28] [29], the PSR series is robust for a wide range of environments. The product line has also been tested for electromagnetic compatibility per the EN 60947-4-2 and IEC 60947-1 general requirements, ensuring reliable operation without disturbing other equipment [30].

Technical Specifications and Model Range

The ABB PSR series covers a **wide range of motor sizes** in a single compact product line. There are 13 models available, designated by their approximate amperage (rated operational current) – from **PSR3** up to **PSR105**. Key electrical specifications for the PSR family include:

- **Operational Voltage:** 208–600 VAC, 3-phase, 50/60 Hz ±5% [27]
- **Motor Current Range:** 3 A to 105 A (AC-53b duty) **– covers motors roughly from** 1.5 kW up to 55 kW** at 400 V (about 2 HP to 75 HP at 460 V) [31] [32].
- **Control Supply (Coil) Voltage:** Either 100–240 VAC **50/60Hz** or 24 V AC/DC (depending on model suffix) [27]. Each PSR starter comes in two control voltage variants to match common control power levels.
- **Adjustable Ramp Times:** 1 to 20 seconds for start (voltage ramp-up), 0 to 20 seconds for stop (voltage ramp-down) [18]. These ranges allow tuning the soft start/stop to the application's needs (short ramps for quick starts or longer for gentler acceleration).
- **Initial Torque/Voltage Kick Start:** Adjustable initial voltage 40%–70% of nominal [33]. This setting determines the **initial torque** boost at startup – useful for overcoming static friction. A higher initial voltage gives more starting torque if needed, while a lower setting makes the start even softer.
- **Internal Bypass:** Yes – built-in bypass contactor closes at end of ramp (at full voltage), minimizing continuous losses. Power loss is very low; for example, the smallest unit (PSR3) dissipates under 1 W at full load, and even the largest (PSR105) only about 6–7 W, thanks to the bypass engaging [34].
- **Starts per Hour Rating: Standard duty – 10 starts/hour**, or **20 starts/hour with added fan cooling** [12]. In lighter-load cases or with significant oversizing, much higher start frequencies (50–100 per hour) are possible without tripping, as ABB notes the PSR can handle up to 100 starts/hour in ideal conditions [13]. The optional cooling fan accessory is available for frame sizes that may need extra cooling for frequent starting duty [35].
- **Operating Conditions:** -25°C to +60°C ambient (above 40°C, derate current ~0.8% per °C) [29]; altitude up to 1000 m without derating (above 1000 m, derate ~4% per additional 500 m) [28]. The devices are protected to IP20 (up to 30 A units) or IP10 on larger sizes where busbar openings are exposed [36]. The control terminals are finger-safe (IP20).

To illustrate the range of the PSR series, the table below lists the available models along with their continuous current ratings and typical motor power capacity:

Softstarter Model	Max Motor Current (AC-53b)	Approx. Motor Power (400 V)
PSR3	3.9 A	1.5 kW (≈2 hp)
PSR6	6.8 A	3 kW (≈4 hp)
PSR9	9 A	4 kW (≈5 hp)
PSR12	12 A	5.5 kW (≈7.5 hp)
PSR16	16 A	7.5 kW (≈10 hp)
PSR25	25 A	11 kW (≈15 hp)
PSR30	30 A	15 kW (≈20 hp)
PSR37	37 A	18.5 kW (≈25 hp)
PSR45	45 A	22 kW (≈30 hp)
PSR60	60 A	30 kW (≈40 hp)
PSR72	72 A	37 kW (≈50 hp)
PSR85	85 A	45 kW (≈60 hp)
PSR105	105 A	55 kW (≈75 hp)

(Above ratings are for normal duty, 40°C ambient, 400 V 3-phase supply. Source: ABB PSR data [31] [37].)

All PSR units are **three-phase controllers** that manage two or three phases of the motor voltage (the control method is optimized for simplicity and smoothness). The control electronics in each unit provide the timed voltage ramp and then activate the bypass at full voltage. On models **PSR25 and larger**, an auxiliary output relay provides a **"Top of Ramp" (TOR) signal** to indicate when the motor has reached full speed (as well as a run indicator relay) [24]. This can be used, for example, to signal other equipment or to switch off a starting resistor or reactor if one is used externally. The PSR's LED indicators also give clear status feedback: a green LED shows power on (ready) status, and another green LED indicates when the device is ramping/running at full voltage [38].

Typical Applications and Use Cases

Because the PSR softstarter focuses on fundamental ramp-up/ramp-down control and compact size, it is best suited for **small to medium motor applications** across a variety of industries. Some common use cases include:

- **Pumps and Water Systems:** Pumping applications benefit greatly from soft starters. Using a PSR softstarter on a pump motor will ramp the pump up to speed gently, **avoiding pressure spikes** in pipes. On stop, the softstop function can mitigate or eliminate *water hammer* – the violent pressure surge that occurs when flow is suddenly halted [39]. This not only protects the pump and piping from mechanical stress, but also reduces maintenance caused by hammer-induced damage. For example, a water utility could replace across-the-line starters with PSR units on its 10 kW well pumps;

immediately, the reduction in starting current and torque will lessen strain on the pump shafts and valves, leading to fewer repairs. (ABB's more advanced softstarters offer specialized pump control, but even the basic PSR's soft stop provides noticeable improvement in many cases.)

- **HVAC Fans and Compressors:** In HVAC systems for commercial buildings, fans and compressors often start and stop frequently. A compact softstarter like the PSR can be integrated into fan starters or small air compressor units to smooth out starting. This has several benefits: **reduced belt wear** in belt-driven fans, less jerking of the fan blades or ductwork, and minimized voltage dips in the facility during motor start. Industry reports have noted that soft starters in HVAC applications lead to longer equipment life and lower maintenance costs by reducing mechanical wear and preventing sudden motor strain [7]. For scroll compressors (e.g. in rooftop AC units or heat pumps), ABB even offers a variant called PSRC with pre-optimized settings for refrigerant compressors [40] – underscoring how valuable soft start technology is in that domain. The standard PSR units can likewise be applied to many light/medium-duty compressors to limit starting torque, which helps prevent compressor damage and light flicker on the electrical supply.

- **Conveyors, Crushers, and Machine Drives:** Manufacturing and material handling systems often involve conveyors, crushers, mixers, and similar machinery driven by electric motors. Direct starting of these can cause **belt slippage, chain stress, or gear shock**, leading to downtime for repairs. Softstarters like the PSR eliminate the sudden jolt by ramping up belt conveyors gradually – the belt tension increases smoothly, protecting both the belt and the product being conveyed. In one study with a 35 kW conveyor drive, a softstarter achieved full speed in half the time of a DOL starter *without* the high current spike, thus reducing mechanical stress on the system [5] [6]. For rock crushers or mixers, the PSR's gentle start can prevent sudden torque spikes that might shear shafts or couplings. Although heavy-duty loads might require larger softstarter models (or the advanced PSTX series for very high power), the PSR is fully capable for many medium-size motors in factories, sawmills, food processing lines, and more – improving reliability by **cushioning the motor and load during each start**.

- **Small Generators and Weak Power Grids:** In installations where the power supply is limited – such as backup generators, rural grids, or solar-plus-inverter systems – using a softstarter can be crucial to avoid voltage sags and generator stalling during motor starts. The PSR softstarter's ability to reduce inrush current (often by more than 50%) means that a smaller generator can start a given motor that would otherwise require a much larger generator if started across-the-line [21] [4]. This is extremely valuable for emergency power setups: e.g., a hospital running a 5 hp HVAC pump on generator can add a PSR, and the motor will start without tripping the generator or causing lights to flicker badly. Similarly in remote areas with weak grid supply, softstarters help **avoid voltage dips** and improve overall power quality by smoothing motor starts [41]. The PSR's compact size and low cost relative to drives make it an economical choice in these scenarios where full speed control (as with a VFD) isn't required.

It should be noted that the PSR series is intended for **normal-duty applications** and standard AC induction motors. For very high inertia loads or extremely frequent starting, one may need to oversize the PSR or consider ABB's heavier-duty softstarter ranges (PSE or PSTX) which include advanced features like current limit and thermal protection. However, within its design envelope, the PSR has proven to be a robust and effective starter. Its simplicity is a virtue in applications that don't demand sophisticated control – fewer components and settings mean there is less to go wrong. Users across industries have reported improved

uptime and gentler machine operation after retrofitting softstarters in place of direct starters [42] [43]. In summary, the ABB PSR softstarter provides an **elegant solution to both electrical and mechanical problems** associated with motor starting, delivering smoother motor control in a compact, easy-to-use package [43].

Conclusion

The ABB PSR softstarter range offers a **balanced blend of simplicity, compactness, and performance** for motor control. It addresses the fundamental challenges of starting and stopping motors by reducing sudden surges in current and torque, thereby protecting both electrical systems and mechanical equipment. With its space-saving design, built-in bypass efficiency, and straightforward 3-pot setup, the PSR is engineered for quick integration and reliable service. It covers a broad spectrum of motor sizes (up to ~105 A/75 hp) and meets international standards, making it suitable for global applications in industries from building services to manufacturing.

While more advanced softstarters and drives exist for specialized needs, the PSR focuses on the core job of **soft starting and stopping with maximum affordability and minimal complexity**. This focus yields high value for customers who need their motors to start smoothly and dependably, without extra bells and whistles. By using ABB PSR softstarters, companies can significantly **reduce maintenance costs, increase equipment life, and improve operational safety** – all by simply changing the way motors are started. In essence, the PSR series demonstrates that even "basic" soft starters can have a profound impact on performance, offering an easy win for engineers looking to **optimize motor-driven systems**. As part of ABB's comprehensive motor control portfolio, the PSR softstarters stand out as a proven solution to help **avoid electrical peaks, mechanical shocks, and downtime** every time a motor is switched on or off [43].

References

1. ABB Low Voltage Products – *PSR Softstarter (Product Page)*. ABB describes the PSR range as a compact, simple soft start solution, handling basic soft start/stop duties and up to 100 starts per hour in suitable applications. *(Source: ABB Global Website)* – new.abb.com
2. ABB **PSR Softstarter – Fact Sheet** (2019). Technical summary of the PSR series, including features like 3 potentiometer setup, integration with manual motor starters for protection, built-in bypass, and starts-per-hour ratings (10 standard, 20 with fan, up to 100 max). Also lists technical data and compliance with IEC 60947-4-2, UL 508, etc. *(Source: ABB Library, Doc ID 1SFC132032L0201)* – ABB Library PDF
3. Switchboard Solutions – *ABB PSR Softstarter – Compact Range Overview*. Contains a breakdown of the PSR product range (models PSR3 through PSR105 with corresponding ratings in Amps and kW), and highlights main benefits (small size, many starts/hour, energy-saving bypass) and features (voltage range, control voltage options). *(Source: switchboardsolutions.co.nz)* – Switchboard Solutions
4. Halcyon Drives – *ABB Softstarters (PSR, PSE, PSTX) Overview*. Provides context on ABB's softstarter ranges. Notes that the PSR series is the most compact (3–105 A) and emphasizes its easy setup and smooth ramping compared to star-delta starters. Also discusses generally how softstarters solve electrical and mechanical startup problems better than traditional methods. *(Source: Halcyon Drives UK)* – Halcyon Drives
5. **Machine Design Magazine** – "Why Motors (and Engineers) Appreciate Soft Starters" by John Bordewick, updated 2023. An article by an industry expert explaining the advantages of soft starters over DOL and wye-delta starting. It details how soft starters reduce inrush current, lessen

mechanical stress on systems (belts, gears, shafts), prevent water hammer in pump applications, and lower electrical peak demands. *(Provides independent validation of soft starter benefits.)* – MachineDesign.com

6. **Journal of Engineering Research and Reports (2024)** – O. I. Jackson et al., *"Comparative Analysis of Direct and Soft Starting Method for Induction Motor..."*. This research paper used simulations of a 35 kW motor to compare DOL vs softstarter starts at various loads. It found the softstarter achieved smoother and faster startups with reduced transient currents, highlighting its superiority for applications like conveyors, pumps, and compressors where minimizing start-up shocks is critical. *(Supports the efficacy of soft starters in reducing stress and improving startup performance.)* – JERR Paper DOI
7. Allied Market Research Blog – *"How Soft Starters Are Revolutionizing Motor Control in Various Industries"* (May 29, 2024). Provides an overview of soft starter use cases across HVAC, water treatment, industrial machinery, and global market trends. Mentions that soft starters' gentle ramp-up improves equipment longevity and specifically notes prevention of water hammer in pump systems and reduced downtime in mining/conveyor contexts. – Allied Market Research Blog

---

1 2 4 21 22 39 42 Why Motors (and Engineers) Appreciate Soft Starters | Machine Design
https://www.machinedesign.com/mechanical-motion-systems/article/21136633/why-motors-and-engineers-appreciate-soft-starters

3 10 13 19 27 PSR - Softstarters | Softstarters | ABB
https://new.abb.com/low-voltage/products/softstarters-new/psr-softstarter

5 6 Comparative Analysis of Direct and Soft Starting Method for Induction Motor on Difference Load Levels | Journal of Engineering Research and Reports
https://journaljerr.com/index.php/JERR/article/view/1308

7 8 How Soft Starters Are Revolutionizing Motor Control in Various Industries
https://blog.alliedmarketresearch.com/key-applicability-of-motor-soft-starters-1996

9 16 20 43 ABB PSR, PSE & PSTX Softstarter Range
https://www.halcyondrives.com/products/abb-softstarts/abb-psr-pse-pst-softstarter.html

11 14 17 18 23 24 25 26 28 29 30 33 34 36 38 search.abb.com
https://search.abb.com/library/Download.aspx?DocumentID=1SFC132032L0201&LanguageCode=en&DocumentPartId=&Action=Launch

12 [PDF] ABB PSR Softstarters - RS Online
https://docs.rs-online.com/8ebe/0900766b8099856c.pdf

15 31 32 37 ABB PSR Softstarter - The compact range - Switchboard Solutions
https://switchboardsolutions.co.nz/product/abb-psr-softstarter-the-compact-range/

35 ABB PSR16-600-70 - Purvis Industries
https://www.purvisindustries.com/abb-psr16-600-70

40 ABB PSRC Softstarters - The compact range, 1PC, brand new | Sunup
https://www.sunupauto.com/1117696.html

41 Induction Motor Soft-Starters and Effects on Power Quality
https://library.powermonitors.com/induction-motor-softstarters-effect-power-quality