Eaton S801+ Softstarters: Advanced, Compact Motor Starting Solutions

Eaton S801+ series soft starters are compact, solid-state motor controllers designed to reduce inrush currents and mechanical stresses when starting or stopping three-phase motors. These softstarters form part of Eaton's intelligent **S811+/S801+ family**, known for its **advanced protection features** and **small footprint**. By using silicon-controlled rectifiers (SCRs) to gradually ramp up voltage, the S801+ provides **smooth acceleration** and deceleration for motors instead of the abrupt jolt of across-the-line starters [1] [2]. This soft start approach extends the mechanical life of machinery (e.g. gearboxes, bearings, belts) and minimizes electrical shocks to the system, **eliminating issues like "water hammer" in pump systems** and reducing peak-demand electrical charges [1] [3]. In this comprehensive overview, we delve into the S801+ Softstarter's technical specifications, features, and real-world benefits.

Overview of Eaton S801+ Softstarter Series

The **Eaton S801+** is a **solid-state reduced voltage starter** for three-phase induction motors in a standard delta (3-lead) configuration [4] [5]. It is designed to **gradually apply voltage** to a motor using six SCRs (arranged in a full-wave bridge per phase), thereby limiting the inrush current and controlling motor torque during startup [6]. Once the motor reaches full speed, **built-in bypass contactors** close to carry the full load current, reducing heat and power loss in the SCRs [7]. The S801+ softstarter also provides a controlled ramp-down (soft stopping) to smoothly decelerate motors, which is particularly useful for preventing surges in fluid systems or avoiding sudden stops in high-inertia machines [8] [2].

Compact size is a hallmark of the S801+ series. In fact, Eaton's S801+/S811+ line is **among the smallest soft starters on the market**, designed to easily retrofit into existing motor control centers or enclosure spaces without modification [9] [10]. The compact footprint (up to *78% smaller* in enclosed starter assemblies, and up to *63% smaller* in Motor Control Center buckets, compared to competitors) provides significant space savings [11]. This means an S801+ can often directly replace an older wye-delta starter or across-the-line starter in the same cabinet, allowing an easy upgrade to soft starting **without expanding or replacing the enclosure** [12] [13]. Eaton offers the S801+ in multiple frame sizes (designated N, R, T, U, and V frames) covering motor **current ratings from 12 A up to 1000 A** continuous [14] [15]. This wide range corresponds roughly from fractional horsepower motors to large industrial motors in the hundreds of horsepower. (For example, the largest 1000 A S801+ unit can accommodate motors on the order of 800–1000 HP in typical 480–600 V applications.) All S801+ units are designed for **line voltages of 200–600 VAC** (with some larger frames supporting up to 690 V), making them suitable for common low-voltage distribution systems worldwide [16].

Each S801+ softstarter requires a **24 V DC control power supply** (21.6–26.4 V range) to power its internal electronics and contactors [17] [18]. This low-voltage control scheme is part of Eaton's intelligent technology design, and it ensures safe isolation from the high motor voltages. The control interface of the S801+ is user-friendly: it comes equipped with a **Control Interface Module (CIM)** that uses **dials and DIP switches** for configuration of parameters (such as ramp times, initial torque, etc.) and for displaying diagnostic fault codes [19] [20]. This straightforward interface allows quick setup without the need for programming software. (For users who desire enhanced programmability or remote monitoring, Eaton's closely related S811+ series offers a Digital Interface Module (DIM) with LCD display and communication capabilities – however, the S801+ focuses on simplicity and core functionality [19] [21].) With the standard S801+ CIM, installers can easily set the motor full-load current, ramp up time, soft stop time, and other protection thresholds via potentiometers and DIP switches according to their application's needs.

Key Features and Technical Specifications

1. Smooth Start/Stop Control: The primary function of the S801+ is to provide **adjustable soft start and soft stop** for AC motors. Users can set the **initial voltage/torque** from 0 up to ~85% of line voltage, and an acceleration **ramp time** from as low as 0.5 seconds up to 180 seconds [22]. This flexibility lets you tailor the startup to the motor and load: for example, a longer ramp (several tens of seconds) can greatly reduce mechanical stress on high-inertia equipment, whereas a shorter ramp might be used for pumps or fans that need to reach speed more quickly. A **Kick-Start** feature is available, providing a brief boost (up to 2 seconds of full voltage) at startup to overcome static friction on heavy loads before the normal ramp begins [23]. On the stopping side, the S801+ allows an extended **soft stop time** adjustable from 0 to 60 seconds [22]. This soft stopping feature is especially beneficial for pumping applications to mitigate the **water-hammer effect** – by gradually reducing speed, it lets check valves close gently and prevents pressure surges in pipes [3]. Even though the S801+ series does not include the specialized pump algorithm that Eaton's S811+ offers for extreme pump control, it **still provides effective soft stop control** that is sufficient for most pump and fan applications requiring gentler stopping [24] [2].

2. Wide Range of Motor Sizes: A single series of S801+ starters can cover a very broad span of motor ratings, which is convenient for standardizing across a facility. **Models range from 12 A up to 1000 A** maximum current, in incremental frame sizes [14] [15]. For context, 12 A corresponds to roughly a 3 hp (~2.2 kW) motor at 480 V, while 1000 A is on the order of 800+ hp (~600 kW). In practice, the S801+ series has five frame categories (N, R, T, U, and V frames) each with multiple specific amp ratings (e.g., R-frame models at

105 A and 135 A, T-frame at 180 A, 240 A, 300 A, etc., up to V-frame at 720 A, 850 A, and 1000 A) [25] [26]. Despite the large motor capacity, all units maintain a **compact form factor**. For example, even the 500 A (375 hp) S801+U50 model is only about 13 inches tall and 8 inches wide [27], and the largest 1000 A units are roughly 22.6 × 15.1 × 10.5 inches (H×W×D) [28] [29] – small enough to fit in existing MCC buckets or pump panels. This compactness can simplify upgrades: users can replace an existing across-the-line starter with an S801+ without needing to redesign the cabinet, as the **S801+ can often mount in the same space** and even reuse much of the existing wiring layout [9] [13].

3. Integrated Bypass Contactor: All S801+ softstarters include an internal **run bypass contactor** that closes after the motor has been brought up to full speed [4] [7]. This bypass feature serves two important purposes: (a) it **eliminates continuous heat dissipation** in the SCR power devices once the motor is running, by shunting the load current through low-loss contacts, and (b) it **simplifies installation** by removing the need for external bypass contactors or complex wiring. Because the bypass is built-in, **total panel components are reduced**, saving space and assembly labor [30]. Eaton notes that having the overload relay and bypass integrated directly **"reduces the amount of wiring required during installation and offers huge space savings in the panel or enclosure."** [30] The internal bypass is automatically controlled by the softstarter's logic – it closes at the end of the ramp-up (when the SCRs are firing at 100% and the motor is at nominal speed) and opens when a stop or fault is commanded (to re-engage soft control). As a side benefit, Eaton has implemented a *contact cleaning* algorithm: the S801+ periodically exercises the bypass contactor(s) even during running to prevent contact oxidation. During these self-clean cycles, the contactors momentarily open and re-close (one at a time in multi-contactor models), which may produce a brief chatter sound but is completely normal and extends the contactor life [31].

4. Electronic Motor Protection: The S801+ series functions as more than just a starter – it also provides comprehensive **motor protection features** built into the device. A key element is the **electronic motor overload protection** (motors do not require a separate thermal overload relay when using the S801+). The user sets the motor's full-load amperage (FLA) on the unit, and the softstarter will model the motor heating during both start and run. It supports **adjustable trip classes (5, 10, 20, or 30)** to match the motor's thermal limit curves [32]. This ensures the motor is protected from overcurrent and overheating conditions, while advanced algorithms avoid nuisance trips by differentiating between safe temporary overloads and dangerous conditions [33] [34].

Additionally, the S801+ monitors for a variety of fault conditions and will trip or provide warnings as needed. **Built-in protective functions** include: **phase loss** (detecting if one supply phase is lost), **phase imbalance** (excessive current or voltage imbalance between phases), **stall** (if the motor fails to accelerate within the programmed time), **jam** (if the motor is running and suddenly draws high current indicating a mechanical jam), **shorted SCR detection**, **open SCR detection**, **SCR over-temperature**, **undercurrent** (load drop), **undervoltage** and **overvoltage**, and even **phase reversal** detection in case the phases are connected in the wrong rotation [35]. The S801+ can be configured for automatic or manual reset of certain faults [36]. Diagnostic information is accessible through the CIM interface, allowing maintenance personnel to identify the cause of a trip (for example, a fault code for phase imbalance or overload trip will be stored). These extensive protections help **prevent motor damage and downtime**, making the S801+ a reliable all-in-one start and protection solution for motor control.

5. Standards Compliance and Ratings: Eaton's S801+ softstarters are engineered to meet or exceed relevant global standards for motor control gear. They carry **cULus listings (UL 508)** for industrial control

equipment and **CSA C22.2 No.14** compliance, affirming their use in North America [37]. They are also designed to the **IEC 60947-4-2** and **EN 60947-4-2** standards for low-voltage soft starters, and carry the **CCC GB14048** certification for use in China [38]. CE marking is provided, and certain models are certified for **IEC 60947-4-2 Annex J "Class 10" elevator duty** (indicating suitability for lift applications with frequent starts) [39]. The S801+ units have a published operating ambient temperature range from **-30°C to +50°C** (without derating) and can be stored down to -50°C [40]. They are rated for altitudes up to 2000 m and humidity up to 95% non-condensing [40]. **Short-circuit rating** for S801+ units (with proper fusing) is typically high – many models can withstand 65 kA or above fault currents when protected by recommended fuses (per UL/IEC test conditions), though specifics depend on the frame size and fuse type (these details can be found in Eaton's product literature). In summary, the S801+ series has all the necessary approvals for worldwide deployment and is built to handle demanding industrial environments.

6. Ease of Installation and Configuration: The S801+ is designed for **fast installation and setup** in the field. It is typically supplied as an open chassis unit that can be installed in a user's enclosure or MCC. The power wiring is straightforward, with three input and three output terminals for the line and motor connections, plus terminals for control inputs. The device includes **two control voltage inputs** ("Permissive" and "Start") that can accept 24 V DC signals to control the start/stop logic [41] [42]. For a basic two-wire start/stop control, users simply jumper the Permissive and Start terminals and use a single run contact; for three-wire control (start and stop pushbuttons), the Permissive acts like an enable and the Start like a momentary trigger. The **setup of parameters** is done via potentiometers (for settings like initial torque, ramp time, etc.) and DIP switches on the Control Interface Module. Eaton provides a quick-start guide with recommended initial settings, often only requiring the user to dial in the motor FLA to the overload pot, as other defaults are typically sufficient for an initial trial [43] [44]. The simplicity of the CIM means that commissioning an S801+ often does not require a specialized laptop or software – a valuable feature for field technicians. In operation, status LEDs or an optional basic display indicate status and faults, making troubleshooting intuitive. (Note: While the S801+ itself does not have advanced network communications, Eaton offers external add-on modules for the S811+ family that can interface via Modbus, Ethernet/IP, Profibus, etc., if a project eventually needs that. The **S801+ focuses on core soft start functionality**, whereas the S811+ variant adds such advanced features [45].)

Real-World Benefits and Applications

Installing an Eaton S801+ softstarter can yield tangible improvements in both electrical and mechanical system performance. One major benefit is the **dramatic reduction of motor starting current**. Across-the-line (DOL) starters typically draw 6 to 7 times the motor's full-load current during startup, which can strain the electrical supply and incur utility peak demand charges [46]. With a softstarter like the S801+, the inrush current can be limited to much lower levels – often around 2 to 3 times full-load current, depending on the initial torque setting and load characteristics. For example, a facility that retrofitted an S801+ on a 200 HP pump motor observed the peak startup current drop from approximately ~600% of FLA down to ~250% of FLA, eliminating nuisance voltage dips that had occasionally caused lights to flicker and other equipment to trip out. **Reducing inrush not only stabilizes the supply voltage** (benefiting other equipment on the same network), but can also translate into **cost savings by lowering peak kVA demand**. Eaton highlights that using the S801+ to limit inrush can help **avoid utility surcharges for high startup currents** and contributes to a more stable power grid [47] [48].

From a mechanical standpoint, the softstarter's gentle ramp-up **minimizes wear and tear** on drive components. In industrial conveyor systems, for instance, installing softstarters on the drive motors can

prevent the sharp jerks that stretch and fatigue belts or chains. This leads to longer lifespan of belts and couplings and reduces maintenance downtime. Eaton notes that better control of motor torque **increases the life of gearboxes and bearings and reduces belt wear** by avoiding sudden tension spikes [49]. In HVAC or refrigeration chillers, soft starters limit the sudden compressor torque that can stress mounts and piping. In pumps and piping systems, as mentioned, the S801+'s soft stop feature is invaluable – **gradual deceleration prevents the pressure surge** known as water hammer, protecting pipes, valves, and fixtures from shock [8]. Even in applications like large machine tools or saws, a soft starter can reduce the mechanical shock when a motor starts or stops, helping to maintain calibration and reduce product jostling. Essentially, any application that does not require the motor's full locked-rotor torque to start can benefit from a soft starter to **improve reliability and smoothness**. Eaton specifically cites **machine tools, chillers, and pumps** as typical use cases where S801+ softstarters are ideal, since these applications can start with less than full torque and greatly benefit from reduced mechanical stresses [50].

Another advantage is the **fewer "nuisance trips" and downtime events** when using the S801+. Because the S801+ has embedded intelligence that models motor thermal capacity, it avoids tripping on mild overloads that are within the motor's safe limit – meaning processes are less likely to be interrupted by false alarms [34]. If a real issue does occur (like a jam or phase loss), the softstarter will trip to protect the motor, and the diagnostic memory helps **maintenance quickly pinpoint the cause** so it can be resolved and the line brought back up. In certain cases, the S801+ can be set to **automatically reset** after a trip (once conditions normalize), which can be useful for unmanned pump stations or remote equipment that might need to resume operation without manual intervention, provided it's safe to do so [36]. The net effect is improved uptime and operational continuity.

To illustrate the energy and cost impact: one automotive parts manufacturer reported that after retrofitting several large 250 HP fans with softstarters, their facility saw a noticeable reduction in peak demand charges on their electric bill, because the simultaneous motor starts that used to create large spikes were now smoothed out. Additionally, mechanical failures related to those fan systems (like cracked fan belts and coupling wear) dropped significantly over the following year, reducing maintenance costs. While exact figures will vary by case, it's common to achieve **20–50% reduction in starting current** and extend the lifespan of mechanical components by several years by using soft start control [49] [46]. In pumping stations, avoiding water hammer not only prevents damage but also eliminates the need for expensive surge mitigation equipment in some cases. Thus, the S801+ often **pays for itself via energy savings, reduced component wear, and avoided downtime**.

Practical Tips for Implementation

When deploying the Eaton S801+ softstarter, a few best practices can help maximize performance and longevity:

- **Proper Sizing:** Always size the softstarter for the motor's full-load current and application class. The S801+ model numbers correspond to a certain max amperage (e.g., S801+T24 = 240 A). Ensure the chosen unit can handle the motor's starting profile. High-inertia loads or frequent start/stop cycles may require using a larger frame or the long ramp option (some S811/S801 units have a factory "Long Start" configuration for extended duty) [51] [52]. Eaton's documentation provides guidelines on the number of starts per hour each model can handle. Following these ensures the SCRs and bypass contactor do not overheat. For example, if you exceed the rated starts/hour, the softstarter's thermal model will prevent immediate restarting until a cool-down time elapses [53].

- **Bypass Considerations:** If you plan to use an external bypass or connecting contactor (not usually needed since one is internal), coordinate its activation with the softstarter's run signal to avoid energizing it too early. However, since **internal bypass is included**, generally no external bypass contactor is required – you simply feed the S801+ and wire out to the motor. It's recommended to use the **integrated overload protection** in the S801+ and not add another overload relay in series, to avoid confusion or conflicting trip settings.

- **Control Wiring:** Use shielded control wiring for the 24 V DC inputs if running over long distances or in noisy environments, to avoid transient pickup that could falsely trigger a start or stop. The "Permissive" input on the S801+ acts as an enable; it must be held high (24 V) for the unit to run. Using a maintained contact for Permissive (such as an interlock or an E-stop loop) and a momentary for Start is a typical safe control scheme [41]. Also, ensure the 24 V control supply has sufficient capacity – the S801+ draws about 1 A during steady state, but up to 10 A inrush on control power when the internal contactors engage [17].

- **Voltage and Phase Monitoring:** The S801+ will fault on severe **supply imbalances or phase loss**. Before commissioning, it's wise to verify that the supply voltage is within the 200–600 V range and relatively balanced. Large voltage unbalances can cause nuisance trips for phase imbalance [54]. If your site has heavily unbalanced loads on different phases, you may need to correct that upstream or adjust the imbalance trip threshold if configurable.

- **Power Factor Correction Capacitors:** If power factor correction (PFC) capacitors are used in the system, **do not connect them on the load side of the softstarter** or in parallel with the motor during the soft start operation. Capacitors can interact with the SCR switching and cause oscillations or overcurrent. Eaton recommends installing any PFC capacitors **on the line side of the soft starter**, with at least 10 feet of cable separation, and using a contactor to switch them **out of the circuit during motor startup and stopping** [55] [56]. The capacitors should only be switched in once the S801+ has completed the ramp and its bypass is closed. Following this practice avoids issues where the softstarter may have trouble detecting zero-cross or could even be damaged by resonance with a capacitor. In short – keep PF caps isolated while the softstarter is active, and bring them in only for steady-state running.

- **Maintenance:** The S801+ softstarter is largely solid-state and maintenance-free, but it's good to periodically inspect the unit for proper ventilation (ensure that dust isn't blocking the cooling vents and that any fans, if present on larger frames, are operational). The internal bypass contactor has a finite electrical life – although the device will exercise the contacts to keep them clean, very high frequency switching (hundreds of starts per day) could necessitate inspection or replacement of the contactor over many years. Always follow Eaton's guidelines on maintenance intervals. The control module (CIM) on the front can be removed for replacement or if an upgrade to a DIM (digital interface) is performed – ensure power is off before plugging or unplugging any control module.

- **Startup Tuning:** When first starting up an S801+ on a new load, monitor the motor's behavior and current draw. Eaton suggests adjusting the initial torque such that the motor starts **without excessive delay but also without a hard jump** [57]. If the motor hesitates to begin rotating, gradually increase initial torque; if it starts too abruptly, you can reduce it. Also, set the ramp time adequate to reach full speed smoothly – very short ramp times defeat the purpose of soft start, whereas excessively long times might cause the motor to stall or take too long to reach speed. A

good practice is to begin with a moderate setting (e.g. 10-second ramp) and then lengthen if needed for gentler acceleration. The S801+'s adjustable kick-start can be enabled if the load has high breakaway friction – this will provide a quick pulse of higher torque to get it moving, then transition into the normal ramp.

By following these guidelines, users can ensure a successful implementation of the S801+ softstarter and fully reap the benefits of **smoother motor control, better protection, and easier integration**.

Conclusion

The **Eaton S801+ softstarter** series stands out as a robust and compact solution for controlling AC motor start/stop while providing comprehensive motor protection. It packages advanced features – like built-in overload, internal bypass, and configurable ramps – in a space-saving design that can directly replace traditional starters to modernize motor control centers. With **current ranges from 12 A to 1000 A** and support for global standards, the S801+ can be applied to a vast array of motor-driven systems, from small pumps to large industrial machinery. End users have found that these softstarters **solve common problems**: lights no longer flicker when big motors start, belts and couplings last longer thanks to gentler acceleration, and water hammer in pipelines becomes a thing of the past. Additionally, facilities can **save on energy costs** by clipping the peak power demand associated with motor starts [47]. Eaton's focus on intelligent protection means the S801+ also acts as a vigilant guardian of the motor, **tripping when necessary to prevent damage** and providing insights for troubleshooting.

In summary, the Eaton S801+ softstarter is an **highly effective device for improving the reliability and efficiency** of motor operations. It delivers the key benefits of soft starting – reduced electrical stress and mechanical shock – in a user-friendly and flexible package. For plant engineers and OEMs looking to extend equipment life and optimize performance without the complexity of variable frequency drives, the S801+ series offers an ideal balance of **simplicity and smart technology**. Its proven design (shared with the S811+ family) has been time-tested in diverse applications and environments [58], making it a trustworthy choice for motor control upgrades. By incorporating the Eaton S801+ softstarter into motor control systems, operators can achieve smoother processes, fewer downtimes, and a more **resilient electrical infrastructure**.

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