Benshaw RB2 Series Soft Starters

Overview

The **Benshaw RB2 Series** is a line of low-voltage solid-state motor soft starters known for their rugged construction and versatile performance. These open-chassis soft starters (meant for installation in an enclosure or panel) cover input voltages from **208 V up to 575 V** and handle motor currents up to **838 A** (approximately 800 HP at 575 V) [1]. Benshaw RB2 units are described as *"field proven, rugged, solid state starters"* designed for use in a wide range of industrial applications [2]. Each starter employs silicon-controlled rectifiers (SCRs) on all three phases to gradually ramp up the motor voltage on startup, thereby limiting inrush current and mechanical shock. Once the motor reaches full speed, an **integral bypass contactor** closes (at the top-of-ramp) and the SCRs stop conducting, which increases operating efficiency and reliability [3]. This built-in bypass design eliminates the need for external bypass contactors or additional cooling fans, since after the motor is at speed the load current flows through the low-loss bypass contactor instead of the SCRs.

Using a soft starter like the RB2 dramatically reduces the electrical and mechanical stresses associated with motor startup. Across-the-line starters (DOL starters), the most common traditional starting method, can draw **6–10 times the motor's full-load current** during startup [4] [5]. This puts tremendous strain on both the electrical supply and the motor itself, leading to voltage dips, excessive heat, and mechanical shock. By contrast, the RB2's controlled ramp-up typically limits the startup current to around **300–400% of full-load amps** (3–4× FLA) [6]. This **gentle starting method** protects the motor's windings and extends the life of driven machinery by avoiding the sudden jolt of full-voltage starts [7]. It also minimizes voltage disturbances in the facility's power system and can reduce peak-demand charges on electrical bills. Common issues like belt slippage, gearbox wear, and water hammer in piping systems are significantly mitigated. For example, in pump applications a soft starter can ramp the motor down slowly at stop – the RB2 offers an adjustable soft-stop – to **prevent the abrupt flow changes that cause pressure surges (water hammer)**, thereby protecting pipes and valves [8] [9]. Overall, the RB2 series provides an easy-to-use solution for **extending motor and equipment life** while improving the smoothness of start and stop operations.

Key Features and Technology

At the heart of the RB2 series is Benshaw's **MX2 control technology**, a proven digital controller platform for motor starting and protection [10]. The MX2 controller offers a rich set of features and configurable options:

- **Multiple Starting Modes:** Users can select from several ramp profiles to match their application's needs. The RB2 supports **voltage ramp**, **current limit ramp**, **torque-controlled ramp**, and even a **power ramp** mode for special cases [11]. These different starting modes allow optimization of the motor's acceleration characteristics – for instance, torque control can provide a more linear acceleration for high-inertia loads, while current limit mode caps the draw to accommodate a weaker power supply or generator. All modes have adjustable parameters (initial voltage/torque, ramp time, etc.) to tailor the soft start precisely [12] [13]. An internal **dual profile** function is available

as well, meaning two sets of ramp settings can be stored (e.g. “loaded” and “unloaded” starts) and the user can switch between them via a digital input for differing load conditions [14].

- **Integrated Bypass and Modular Design:** The RB2 includes an internal bypass contactor that bypasses the SCRs at the end of the start ramp [15]. This feature simplifies installation and improves efficiency during run by reducing heat generation. The power section has a **modular design with separate SCR modules for each phase** [15], which aids in serviceability – an individual phase module can be replaced if needed without replacing the entire starter. The power electronics are designed for heavy-duty performance (the RB2 uses high-voltage SCRs with **1800 PIV** rating for robust operation on 480–600 V systems [16]). The overall construction is built to handle the thermal and electrical stresses of repeated motor starts.

- **User-Friendly Interface:** Programming and monitoring are done through a **board-mounted LED keypad/display** on the RB2, and an **optional remote-mount LCD keypad** is available for door mounting (making it convenient when the starter is inside a panel) [17]. Commissioning is simplified by a guided **Quick Start menu** that groups the most commonly used parameters for easy setup [18]. The RB2 also provides full access to configuration via **Modbus RTU** communication as a standard feature (over an RS-485 port), allowing integration with PLCs or plant SCADA systems. For advanced networking needs, the platform supports optional fieldbus modules – including **EtherNet/IP, Modbus TCP, Profibus,** and **DeviceNet** – which can be added to enable those protocols on the RB2 [19]. This flexibility makes it straightforward to incorporate RB2 starters into modern industrial control architectures and IIoT monitoring solutions.

- **Advanced Diagnostics and Protection:** The MX2 controller continuously monitors motor and system parameters. The unit includes built-in metering (volts, amps, frequency, power, power factor, etc.) viewable on the display or accessible via communication [20] [21]. It also logs up to 99 events/faults in an event log for troubleshooting purposes [22] [23]. The **motor protection features** are comprehensive (described in detail in the next section), and many can be configured to either trip or just issue a warning. Notably, the RB2 has a feature to perform a “controlled fault” stop – if a fault occurs, the unit can optionally ramp the motor down instead of an immediate coast stop, which might be useful in certain process situations. The MX2 also supports an optional **real-time clock** for timestamping events or for use in scheduled starts/stops. In terms of safety, the controller has built-in self-test diagnostics and will check critical hardware (like the SCR firing circuitry) at power-up. All these capabilities contribute to more **predictable and reliable motor control**, with ample feedback to the user/operator.

From a hardware and reliability standpoint, the RB2 series is built to high standards. It is **UL certified (UL 60947-4-2)** and CE compliant to IEC/EN 60947-4-2 for motor controllers [16] [24], and carries a **NEMA-rated 3-year factory warranty** on parts and workmanship [25]. The RB2 starters are compact for their power range; for example, the largest 838 A (800 HP) frame measures about 31 × 27 × 13 inches and weighs roughly 160 lbs [26], which is advantageous where panel space is at a premium. Benshaw’s design emphasizes heavy-duty performance and longevity – the device can endure frequent starts and high overloads (within its ratings) without derating, and it features ample surge voltage immunity and R-C snubber networks to protect the SCRs from transient spikes. In practice, the RB2 units have been proven in the field in applications ranging from HVAC compressors to rock crushers, demonstrating both the **flexibility of configuration** and the toughness of the power electronics under harsh conditions.

Performance Ratings and Duty Classes

One of the key considerations when selecting an RB2 soft starter is the **duty class** required for the application. Benshaw offers each RB2 model in three duty ratings: **Standard Duty, Heavy Duty, or Severe Duty**. These classifications pertain to the **overload current capacity and duration** that the starter can handle during motor start (as well as the continuous current capability). According to the manufacturer specifications, the ratings are as follows:

- **Standard Duty (Normal Duty):** Can handle up to **350%** of the motor's full-load current for **30 seconds**, and is rated for **115%** of full-load current on a continuous basis [27]. In other words, in standard duty the starter can allow approximately 3.5× FLA during a typical acceleration ramp and can tolerate modest overloads (up to 1.15 service factor) continuously. This is suitable for applications with relatively easy starts – fans, centrifugal pumps, and other loads with normal startup torque. The electronic thermal overload in standard duty is normally set to a **Class 10** curve (trips in ~10 seconds at 600% current) [28], matching the motor's thermal limit for across-the-line starts. The RB2's power stack is designed for Class 10 duty **without requiring any derating** under nominal conditions [29] (ambient temperature within spec, etc.), which attests to its robust design.

- **Heavy Duty:** Can handle up to **500%** of full-load current for **30 seconds**, with a continuous current capability of **125%** FLA (1.25 service factor) [30]. The higher surge capacity (5× FLA for 30s) is intended for more demanding starts or more frequent start/stop duty. Heavy-duty models are often chosen for loads like loaded conveyors, crushers, or large fans/blowers that have higher inertia or starting friction. In heavy-duty mode, the RB2's overload protection can typically be adjusted to a **Class 20** trip curve (allowing a longer 20-second trip time at 600% current) [31] [28] to accommodate the longer high-current duration. The starter's design in this mode can handle the additional thermal stress – for example, heat sinks and SCR ratings are sized such that 500% for 30s is sustainable without damage. Heavy-duty RB2 units also have the same 125% continuous rating, meaning they can support motors with higher service factors or applications that may occasionally overload the motor for extended periods.

- **Severe Duty:** Can handle up to **600%** of full-load current for **30 seconds**, with a **125%** FLA continuous rating [32] (same continuous as heavy duty). This roughly 6× current capacity for a full half-minute is among the highest ratings in the industry for low-voltage soft starters. The severe-duty rating is intended for extremely hard-starting loads – think of applications like rock crushers, positive displacement pumps starting against head pressure, long conveyor belts fully loaded from rest, or mixers with heavy material. In such cases, the motor needs a very high starting torque (and current), and the RB2 in severe-duty configuration can accommodate that. The overload may be set to Class 20 (in some cases Class 30 if allowed) to permit the high current for longer without tripping. Notably, not all RB2 frame sizes are utilized in severe duty for the largest motors; often one would select the next size up if a severe start is required. For example, a unit that might run a 500 HP motor in standard duty might only be good for ~400 HP in severe duty – Benshaw's selection tables reflect this de-rating for tough starts [33] [34]. Essentially, **the same hardware supports less motor HP when used in heavy or severe duty mode**, because it's being asked to handle higher stress. Even so, the RB2's severe-duty capability (6× FLA for 30s) is a standout feature, as many competitive soft starters are typically limited to ~4× or 5× FLA for similar durations.

In practice, choosing the duty class comes down to the application's demands. Benshaw's documentation guides users to select **Standard Duty for normal centrifugal loads**, Heavy Duty for heavier loads or higher starting frequency, and Severe Duty for the most extreme cases (high inertia or heavily loaded starts). It's worth noting that the **continuous current ratings** also differ: Standard duty RB2 starters are limited to about 115% continuous (which aligns with typical motor service factor 1.15), whereas Heavy and Severe duty versions allow up to 125% continuous (service factor 1.25) [27] [30]. This is important if the motor may be overloaded in normal running (for example, driving a process that can occasionally exceed 100% load) – the heavy/severe versions of the RB2 can handle that better without tripping. In all cases, the RB2 includes thermal modeling in its controller to protect the motor; you program the motor's full-load amperage and service factor, and the unit will trip on overload if the motor is running beyond its thermal limit (with different trip times for class 10/20 as set). The **robustness of the RB2 design** is highlighted by the fact that even in severe duty, it can sustain very high currents for short periods – the power devices and heatsinking are built to absorb the associated thermal energy. Of course, if starts are extremely frequent or ambient temperature is very high, some additional cooling or a higher-rated unit might be needed, but for most typical use cases the RB2's specified duty cycles do not require further derating in standard environments.

Motor Protection and Safety Features

While soft starters are primarily used for controlling the voltage ramp to the motor, the RB2 series also functions as a **comprehensive motor protection system**, often eliminating the need for separate overload relays or protective devices in the starter panel. The integrated **MX2 control** provides a suite of protective features that safeguard both the motor and the starter itself. Key protection functions include:

- **Electronic Thermal Overload:** The RB2 continuously calculates the motor's thermal state using an I^2t model. It provides adjustable **motor full-load current (FLA)** and **service factor** settings so that the built-in overload relay can mimic the time-current trip curve of a traditional heater element. As noted, it supports **Class 10, 20** (and higher) trip curves as needed for the application. This thermal protection guards against sustained overcurrent that could overheat the motor windings. It also has a cool-down memory: if the motor was running hot and is then stopped, the RB2 "remembers" the thermal state so that a restart can be blocked or accelerated trip will occur if the motor hasn't had sufficient cooling time. In essence, the RB2's overload functions just like a high-quality electronic overload relay integrated into the soft starter.

- **Phase Loss and Phase Reversal Protection:** If any of the three supply phases is lost, or if the phase rotation is wrong (which would cause the motor to run in reverse), the RB2 will detect this and inhibit the start or trip off. Running a three-phase motor with a missing phase can quickly cause catastrophic heating, so phase-loss (single-phasing) protection is critical. The RB2's controller monitors current/voltage imbalance to detect a lost phase condition. **Phase reversal** protection ensures that the motor doesn't run backwards due to miswired lines – this is particularly important for pumps or other equipment where reverse rotation could cause damage. The RB2 will fault out if the phase sequence isn't the same as what it was programmed to expect (typically the starter "learns" the correct phase sequence on the first successful start). These protections act within a second or less of a problem being detected.

- **Current Imbalance and Under/Overcurrent:** The RB2 monitors current on all phases and can detect imbalance or phase unbalance conditions. Excessive current imbalance (beyond a set threshold) will cause an alarm or trip, as it often indicates issues like a phase loss, a blown fuse, or

motor winding problems. The controller also offers **undercurrent (underload) protection** and **overcurrent protection** outside of the standard overload curve. Undercurrent protection can sense if a motor that should be under load suddenly drops in current – for example, if a pump loses prime or a fan belt breaks, the motor current falls and the RB2 can trip on underload to prevent running in a no-load condition that might be undesirable [35] [36]. Overcurrent (instantaneous) protection can detect sudden spikes (like a short-circuit or stall) and shut down faster than the time delay of the thermal overload. This acts somewhat like a phase-failure or short-circuit protection, though for full high-fault protection a coordinated fuse or circuit breaker is still used upstream. The RB2's **motor protection menu** allows separate settings for things like "Stall Time" (maximum time it will allow locked-rotor current before tripping) and "Jam Detection" (if the motor, after reaching full speed, suddenly draws excessive current, indicating a mechanical jam). These features collectively ensure that the motor is not subjected to damaging conditions without the starter intervening.

- **Voltage and Power Protection:** The RB2 can protect against abnormal supply conditions as well. It includes **low line voltage protection** (if supply voltage drops too far, it can trip to avoid undervoltage stress on motor) and monitors for **voltage imbalance** between phases [37] [38]. An **over-voltage trip** is also available, which can detect if the line voltage exceeds a programmed threshold (useful in some situations like generator-fed systems or open-transition transfers where surges might occur). The RB2 also watches the **line frequency** and can be set to trip on significant deviations (this is more relevant in generator applications or unstable grid scenarios). On the power side, the MX2 controller has an internal **power factor and power (kW) calculation**, and while it doesn't typically trip on power factor, it uses this information for advanced features like "Power metering" and possibly an energy-saving mode for lightly loaded motors. It also offers a configurable **power loss (phase failure) trip** which overlaps with the phase-loss detection mentioned earlier. Additionally, the RB2 can detect **ground faults**: with an external or residual connection, it can measure ground current (e.g. via a core-balance CT or using the residual sum of phase currents) and trip on ground fault conditions [39]. This typically is set up to detect low-level ground faults that wouldn't blow a fuse immediately but could damage motor insulation.

- **Other Protections:** The RB2's protection suite goes on to include **motor stall** (if the motor fails to accelerate to full speed in the programmed time, it will trip to prevent burnout), **start-time limit exceeded**, **excessive starts per hour** (to prevent overheating from too frequent cycling), and protection against **SCR faults** or misfiring. The controller will diagnose internal issues like an SCR shorted or an open gate circuit and provide an alarm. There's also a feature to monitor the **internal power stack temperature** – if the soft starter's heat sink gets too hot (perhaps due to high ambient temp or too many rapid starts), the RB2 will trip on over-temperature to protect itself. Many of these protections have adjustable threshold and delay settings in the RB2's programming, allowing coordination with system requirements. For example, you might set a 1-second delay on phase loss to ride through a very brief dip, or adjust the ground fault trip level if using an external CT. The flexibility is similar to that of a modern motor protection relay.

- **Controlled Stop (Soft Stop):** In addition to controlling the startup, the RB2 can also provide a **soft stop (voltage ramp-down)** for applications that need a gentle deceleration. This is particularly useful for liquid pumping systems where water hammer is a concern. By gradually reducing the voltage (and thus torque) after a stop command, the soft starter lets the motor and connected load coast to a stop more slowly than an abrupt coast or brake. The RB2's soft stop time is adjustable, and Benshaw even provides a specialized *pump control* option (sometimes called an S-curve or pump

ramp-down) that tailors the deceleration to avoid pressure surges [40] [41]. For example, in a water supply network, using the RB2 to softly stop pumps can **greatly reduce or eliminate pressure "hammer"** and associated pipe stresses [8]. Not all soft starters include a true soft-stop function, but the RB2 does, and it can be a cost-effective way to avoid needing motor-operated valves or other anti-surge measures in fluid systems. Besides pumps, soft stop can also benefit applications like grain elevators or conveyors, where you want to avoid abrupt jolts when stopping the material flow.

- **Emergency Shutdown and External Inputs:** The RB2 provides inputs that can be used for external fault conditions. There is a dedicated **remote trip input** (often used for things like an external E-Stop pushbutton or interlocks from other equipment). When asserted, it immediately trips the soft starter and removes power from the motor (or performs a controlled stop, depending on configuration). Additionally, the RB2 can accept **PTC thermistor inputs** from the motor (if the motor has built-in temperature sensors in its windings) to perform a thermistor over-temperature trip – this offers direct motor temperature protection beyond current-based estimation. There are also provisions for **RTD modules** to be connected (as listed in the brochure features), which can monitor bearings or ambient temperature, although those are more commonly used with the MX3 controller. For most standard setups, the built-in protections suffice, but these extra inputs allow integration into a wider safety system. The RB2 has several output relays as well, which can be configured for functions like "Fault", "At Speed", "Bypass Closed", etc., to interface with other controls or indicator lamps.

In summary, the RB2 series soft starters not only ramp the motor but also serve as a **full-fledged motor protection unit**. This integration is convenient and cost-saving for users. All protection and event data are accessible via the keypad or the communications port, so one can quickly see what caused the last trip (e.g. "Phase Loss" or "Overload Trip") and take corrective action. The protective functions conform to industrial standards for motor control – for instance, the overload function is UL listed as a Class 10/20 motor protector, and ground-fault protection meets applicable codes for detecting leakage currents. By using the RB2, users gain confidence that their motor is monitored and will be **automatically shut down in a controlled way if any abnormal or dangerous condition arises**, helping to prevent equipment damage or downtime.

It's worth noting that Benshaw provides an **exclusive three-year warranty** on RB2 series starters [25]. This warranty reflects the reliability of the design and also provides end users with peace of mind. In critical applications (such as 24/7 manufacturing processes or large HVAC systems), having a dependable starter with robust protection can save thousands of dollars by avoiding failures. Benshaw's warranty and support network (including field service and technical support) further ensure that the RB2 series can be used with confidence in demanding industrial environments.

Installation and Usage Considerations

The RB2 series soft starters are **open chassis units**, which means they are typically mounted inside a suitable electrical enclosure or integrated into a motor control center (MCC) cabinet. When installing an RB2, one must ensure that the **enclosure provides adequate environmental protection** (dust, water, corrosives) and cooling for the starter. Because of the integral bypass, the RB2 generates relatively little heat during run (since the SCRs are not carrying current except during starting). However, during the motor start period, the SCRs do dissipate heat, so some ventilation or heat-sinking via the enclosure is needed. Benshaw's manuals provide heat dissipation values for each model to aid in thermal management. It's generally recommended to have some clearance around the unit for air flow and to avoid placing heat-

producing devices directly below it in a cabinet. If multiple soft starters or drives are in the same enclosure, additional fans or cooling may be required to keep internal temperatures within limits.

Wiring the RB2 is straightforward, akin to a traditional starter. **Line power (three-phase input)** connects to the RB2's terminals marked for line, and the **load (motor) leads** connect to the terminals marked for load. The control voltage (the RB2 uses a control supply, often 120 VAC or 230 VAC depending on model, to power its electronics and contactor) needs to be provided as well – this powers the MX2 control board and the bypass contactor coil. Control wiring will include the Start and Stop commands (which can be wired to the RB2's digital inputs or done via network control if using communications). The RB2 can be configured for 2-wire or 3-wire start/stop control schemes. There are also terminals for any external trip input or interlocks (for example, you might wire an auxiliary contact from an upstream breaker such that if the breaker trips, it signals the RB2 to drop out as well).

Because the RB2 is a solid-state device, certain practices should be observed: Upstream protection should be provided by properly sized fuses or a circuit breaker **rated for semiconductor protection** – this ensures that in the event of a short-circuit, the SCRs are protected from excessive let-through current. Benshaw typically recommends High-Speed fuses or latest-generation MCCBs with adjustable magnetic trips for this purpose, and provides tables of recommended fuse part numbers for each RB2 model. Additionally, if the installation is in an area with frequent lightning or switching surges, installing surge protective devices (SPD) on the line side is a good idea to protect the solid-state components. The RB2 has built-in MOVs or snubbers for typical transient levels, but very large surges are best arrested by external surge protectors.

Another consideration is the **bypass contactor operation**. The RB2's internal bypass closes automatically at the end of the ramp – users do not need to control it – but it's important that any external control knows when the motor is up to speed. The RB2 provides a relay output (often designated "Up-To-Speed" or "Bypass Closed") which can be wired to indicate that the motor is running at full voltage. This can be useful, for example, to signal a pump valve to open only after the motor is at speed, or to let a PLC know it can now apply load to a started machine. During starting, the RB2 can also be configured to output a "ramping" status via another relay if needed.

Integration with systems: The RB2 can be easily integrated into larger control systems. Its Modbus RTU communication can be connected to a PLC or SCADA to allow remote start/stop and monitoring of parameters like current, voltage, and device status. This is valuable in automated plants – for instance, an operator at an HMI can start a motor and see in real-time the current ramp profile or any fault that occurs. If using one of the optional communication modules (Ethernet/IP, Profibus, etc.), integration is similarly straightforward, and the RB2's registers include all the key data (current, voltage, power, status bits for each protection, etc.). From a programming standpoint, controlling an RB2 via network is not much different than controlling a variable frequency drive: you typically send a start command and maybe a speed reference (in the soft starter's case, the "speed" reference is essentially telling it to start at the programmed ramp).

Because the RB2 is open chassis, when retrofitting it into an existing starter enclosure, one often replaces the old starter (whether it was an autotransformer, star-delta, or across-the-line unit) with the RB2 unit mounted on a back panel. The RB2's compact size helps here. It often occupies less space than electro-mechanical reduced-voltage starters of equivalent motor size. However, it will typically require a small control transformer (if control power is derived from high voltage) and perhaps an external bypass contactor if one chooses to have an **across-the-line backup starter**. In some critical applications, users

implement a bypass scheme where if the soft starter fails, an electromechanical bypass can take over to run the motor DOL. Benshaw's combination starters (the RX2E series) incorporate an external bypass switch for this purpose. If a manual bypass is desired, it's crucial to include electrical interlocks so that the RB2 is not energized when bypassed and vice versa, to avoid back-feeding the SCRs. In general, though, the RB2's internal bypass is sufficient for normal operation and no external starter is needed.

Maintenance on the RB2 soft starters is minimal because there are no contacts that wear out as in traditional starters (the internal bypass contactor does switch, but it handles load current only after the SCRs have done the stressful part of starting). The main thing is to keep the unit clean and cool. Periodic inspection might include blowing out any dust from the heatsinks and checking that control terminals are tight. It's also a good practice to verify the tightness of the power connections after the first few start-stop cycles, as the heating and cooling can sometimes cause lugs to settle. The RB2's SCRs are solid-state devices with a long life if not overheated; running within the specified duty cycle, they can perform tens of thousands of start cycles. If an SCR were ever to fail (due to extreme surge or overvoltage), it usually fails shorted – the RB2 has a fault detection for that (it would detect current flow when it's supposed to be off). Replacing an SCR module typically involves removing the particular phase's assembly; Benshaw can supply replacement SCR modules for the RB2 if needed. Again, this is rarely needed if the unit is applied within spec. Benshaw's 3-year warranty and support indicate the confidence in reliability – many users report long service life from these starters.

In terms of **user training**, the RB2 is relatively easy to understand for anyone familiar with motor starters. Benshaw provides a detailed user manual and quick start guide. The keypad interface shows plain-English codes for parameters and faults (and multiple language support is available). During operation, the display can scroll through metered values or simply show status (e.g. "ramping" or "at speed"). LED indicators on the board often show statuses like "Power On", "Running", "Fault" for quick reference. All these little design features contribute to a **user-friendly experience**, reducing the learning curve and making the RB2 series suitable for both new installations and retrofit upgrades of older systems.

Real-World Application Examples

To better understand the benefits of the RB2 soft starter, consider a few real-world scenarios where soft starters make a significant difference:

- **Pumping Application (Water/Wastewater):** A municipal water pumping station had 150 HP pumps driven by across-the-line starters. Whenever a pump stopped, the sudden cessation of flow caused intense water hammer – pressure spikes that rattled pipes and frequently led to leaks at joints and stress on valves. The startup inrush currents were also putting a strain on the backup generator and utility feed (each start drew about 6–7× the motor FLA, causing noticeable voltage sags in the facility). By retrofitting Benshaw RB2 soft starters on these pumps, the facility was able to implement a **soft start and soft stop** profile. The pumps now start with a smooth voltage ramp over 10 seconds, limiting the peak current to around 300% FLA instead of 600–700% previously. This gentle start not only reduced the electrical stress (the generator no longer trips on high load when a pump starts, and the utility power quality is maintained), but it also reduced mechanical stress on the pump couplings and shafts. More dramatically, the **soft stop function eliminated the water hammer** – instead of slamming to a stop, the pump ramps down over about 15 seconds, giving the water column time to decelerate gradually. After this retrofit, the maintenance team noted a complete stop to pipe leak incidents related to pressure shock, and the lifespan of check valves and

seals improved. Additionally, the pumps' frequent start/stop cycles (as they respond to demand throughout the day) no longer cause temperature spikes in the motors, whereas before the motors ran hot from repeated inrush heating. This example illustrates how the RB2's features directly translated to reduced maintenance and energy costs (fewer repairs and lower peak demand charges), as well as improved system reliability.

- **High-Inertia Fan Application (Industrial HVAC):** A large air handling unit in a manufacturing plant uses a 200 HP induced-draft fan with a heavy steel impeller. The fan previously used an old autotransformer starter (2-step reduced voltage). Even with that, the starts were abrupt and caused belt squeal and occasional belt breakage due to the sudden torque. The plant upgraded to an RB2 soft starter in **heavy-duty mode** (to allow a longer ramp for the high-inertia load). With the RB2, they configured a 20-second voltage ramp and enabled the current limit at 450% FLA to ensure the fan could overcome inertia without exceeding the starter's capacity. The result was a **much smoother acceleration** – the belt drive sees a gradual increase in tension rather than a jolt. Over a year of operation, the plant observed that belt replacements dropped dramatically (the maintenance interval for belts went from 6 months to well over a year), and motor drive-end bearing temperatures decreased (likely because the soft start reduced mechanical stress on the motor shaft and bearing during startup). The softer starts also eliminated the nuisance tripping of the upstream breaker that occasionally happened with the autotransformer starter (when the second tap would kick in, sometimes the current spike still hit the trip threshold). In terms of electrical performance, the soft starter's current limit kept the line draw well within acceptable range, and power factor during start was also better controlled. The operators commented that the fan "sounds better" during startup – it comes up to speed in a controlled way with no sudden whoosh, which also improved the airflow control in the process. This scenario shows how the RB2 in heavy-duty configuration handled a difficult load and provided both **mechanical and electrical benefits**.

- **Conveyor/Crusher Application (Mining/Aggregate):** In a quarry operation, a long conveyor (driven by multiple 100 HP motors) and a rock crusher (400 HP motor) were sources of frequent downtime. The direct-on-line starting of the crusher often caused voltage dips that would reset other equipment, and the mechanical shock would stress the crusher's drive couplings. The conveyor, when fully loaded, had trouble starting and would occasionally trip out the motor on overload if started under load. By installing RB2 soft starters (severe-duty rated) on these motors, the operation was able to **ramp up the machinery gradually**. The crusher's 400 HP motor, for instance, is now started with a 15-second current-limit ramp (set to about 500% FLA), which avoids excessive torque spikes. The electrical system no longer experiences huge instantaneous current draws, and other motors on the same bus no longer dip or trip out during startups. Mechanically, the crusher comes up to speed without the loud "clunk" that used to occur, indicating reduced stress on gears and couplings. For the conveyor, the soft starter allows it to start loaded – previously they had to empty the conveyor or risk a stall on start. The RB2 in severe duty handles the high inertia of a loaded belt by allowing up to 6× current for a short period; the conveyor now reliably starts full of material without tripping. This has improved throughput (less downtime clearing belts) and protected the motor and belt from the strain of stall conditions. In terms of numbers, the peak current on the conveyor start went from ~600 A (tripping at times) down to about 300–350 A with the soft starter, and start time went from ~2 seconds (brutal but brief) to ~10 seconds (smooth). The slightly longer start time is easily absorbed in the process and is a non-issue, whereas the benefits are substantial in maintenance savings. This example highlights how **heavy-duty soft starters like the RB2** can be game-changers in industries where shock loads and high inertia are common – they allow the

equipment to start in a controlled manner that **avoids both electrical nuisance issues and mechanical wear and tear**.

These scenarios underscore a broader point: modern soft starters such as the RB2 series give industrial operators a high degree of control over motor acceleration and deceleration, which translates to tangible improvements in system performance and longevity. In contrast to an alternative like a variable frequency drive (VFD), a soft starter provides *only* the soft-start/stop function (no speed control once at full speed), but it does so with **lower cost, smaller size, and typically higher efficiency at full load** (since it bypasses once at speed) [42] . For fixed-speed applications where the goal is to mitigate start/stop issues, soft starters like the RB2 are often the optimal solution.

Industry Context and Comparisons

Soft starters are widely used across industries, and many major manufacturers produce similar low-voltage soft start devices (often in competition with Benshaw's offerings). For example, ABB's PST(X) series, Schneider Electric's Altistart series, Eaton's S811+/S801, Rockwell Allen-Bradley's SMC-3/50/Flex series, and others serve the same fundamental purpose. All of these devices, including the Benshaw RB2, are designed to **reduce inrush current and mechanical stress on startup** for AC motors [7] . The core principles – ramping voltage to limit current, offering some motor protection, and often providing soft stopping – are common across brands.

Where the Benshaw **RB2 series stands out** is in its combination of heavy-duty performance and user-oriented features. Notably, the RB2's **600% severe-duty rating** for 30 seconds is at the high end of the spectrum; many competitors might offer 500% for 20 seconds or similar. This makes RB2 particularly attractive for very demanding applications, as it can handle tougher starts without oversizing. Benshaw also emphasizes the modular design and maintainability (separate phase modules, etc.), which not all soft starters do – some competitor units have all SCRs on a single large heatsink, for example. The RB2's **MX2 control platform** is admittedly an earlier-generation technology compared to Benshaw's newer **MX3 (used in the RB3 series)**, but it is still quite feature-rich. In fact, MX2-based starters like RB2 gained a reputation for reliability and simplicity – some users prefer them for being proven over decades. The MX3 added more advanced communications and a few more features, but for most practical purposes an RB2 and RB3 perform similarly on a motor.

In the broader context, soft starters fill a middle ground between across-the-line starters and full variable frequency drives. They are often the preferred solution when *full speed control is not required*, but gentler starting/stopping is desired. They tend to be **more economical than VFDs**, especially in large horsepower ranges, and **take up less space and generate less heat** since they only regulate voltage during starting and then essentially drop out of the circuit [42] . The trade-off is that they do not improve running efficiency or offer speed variation – once the motor is at full speed, it runs across the line. In many applications (pumps, fans with dampers, conveyors with fixed speed), that is perfectly fine. Benshaw's RB2 has been successfully used in all these scenarios. For instance, in HVAC systems, soft starters are commonly used to limit inrush on large chillers and blowers. In oil & gas, soft starters start large compressors or pump jacks to avoid mechanical stresses on rods and shafts. In marine applications, soft starters can limit starting currents to avoid tripping generators on ships. The RB2 series, with its robust design, finds itself in all these industries.

When comparing to similar products, one might look at features like: **communication options** (RB2 is strong here, supporting all major protocols via modules), **built-in protections** (RB2 is very comprehensive, essentially meeting ANSI/NEMA motor protection functions as seen in its specs), and **ease of use**. RB2's competitor from ABB, for example, the PSTX, includes an even more advanced interface (graphical display, etc.) and a few more bells and whistles (like built-in clock, programmable analog outputs standard), but those come at a higher price point. Eaton's S811+ starters have a somewhat simpler keypad and slightly lower current ratings for heavy starts (typically 500% for 30s max). All these units do the job; choosing often comes down to **specific application needs and support**. Benshaw as a company often focuses on heavy industry and quick delivery – the RB2 starters are **available from stock in many ratings**, which can be a decisive factor if a user needs a solution fast (for example, if a starter failed at a plant and they need a drop-in replacement next day). Precision Electric (and other distributors) often carry RB2 units for this reason – they are seen as a reliable, readily available solution.

It's also worth noting that the RB2 series can be integrated into **custom OEM solutions**. Benshaw frequently works with OEMs of machinery to provide soft start modules or even entire control panels. The RB2's **modular nature and communication abilities** make it relatively easy to incorporate as a subsystem in a larger control scheme. An OEM building, say, compressor packages might use an RB2 as the standard starter in all their units, knowing it covers a range of HP and will protect the motor. They can standardize on the RB2's footprint and interface. Because the MX2 control can be remote-controlled and monitored, the OEM's system can even log starts, run hours, etc., via the soft starter's data – this can feed into predictive maintenance.

In terms of **trends**, while VFDs have become very popular, soft starters like RB2 remain indispensable for very large motors where VFD costs or efficiency losses would be prohibitive. They also have a simplicity and reliability advantage: a soft starter like RB2, once the motor is at speed, has no active electronics handling power (the SCRs are bypassed), so essentially the motor is running as if directly connected to the line. This means no harmonics during run (which VFDs always introduce), and no additional heat or risk from the electronics while running. Many facility engineers appreciate this simpler approach for appropriate applications, citing that *"soft starters generate lower inrush and stress, but otherwise let the motor run naturally – which extends the motor's life"* [7] [43]. Soft starters also don't need input filters or special shielding for cables, etc., that VFDs often require. Thus, devices like the RB2 continue to be highly relevant and are likely to remain so for the foreseeable future in the motor control landscape.

In summary, the **Benshaw RB2 Series soft starters** are a robust and well-engineered solution for controlled motor starting. They encapsulate the key benefits of soft start technology – **limiting electrical inrush, reducing mechanical shock, and providing intelligent motor protection** – in a user-friendly package with a proven track record. Whether it's reducing water hammer in pipelines, preventing belt and gear damage in conveyors, or simply avoiding high starting currents that dim the lights, the RB2 series offers a reliable way to bring motors from zero to full speed **smoothly and safely**. Backed by Benshaw's long experience in solid-state controls and supported by extensive documentation and service, the RB2 soft starters can be confidently applied across industries to improve system performance and protect critical motor assets.

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