# Benshaw RX2E Softstarters – Comprehensive Technical Overview

**Benshaw RX2E** is a series of enclosed combination soft starters designed for heavy-duty motor control applications. These soft starters provide **reduced-voltage motor starting** to minimize inrush currents and mechanical stress, while also offering a unique **dual-redundant starting capability** – meaning they can function as a solid-state soft starter during normal operation, or as a full-voltage starter via an integrated bypass for emergency backup [1] [2]. This robust design, combined with built-in digital motor protection and control features, makes the RX2E series an ideal solution for critical applications where downtime is not an option. In this overview, we delve into the RX2E's features, specifications, technology, and the benefits it brings to motor control in industrial settings.

## Overview of the Benshaw RX2E Series

The **Benshaw RX2E series** soft starters are packaged motor starters that come as a complete assembly in a heavy-duty enclosure (available in **NEMA 12** indoor or **NEMA 3R** outdoor ratings) [3] [4]. Each unit includes all necessary components for motor starting and protection, pre-wired and ready to use. Key built-in components are a **molded-case circuit breaker**, a **full-voltage bypass contactor**, door-mounted operator controls (Start/Stop pushbuttons, a Local/Off/Remote selector switch), and an LCD keypad interface for programming and monitoring [5] [4]. The figure below shows an example of an RX2E enclosed soft starter, with its rugged metal enclosure and door-mounted controls:

*An example of a Benshaw RX2E enclosed combination soft starter (door closed). The unit integrates a soft starter module, main circuit breaker, bypass contactor, and user controls (HMI keypad and pushbuttons) in a NEMA-rated enclosure.*

Notably, the RX2E is described by the manufacturer as "a rugged, simple to use soft starter with built-in motor protection, providing greater control in the starting and stopping of three-phase motors" Benshaw RX2E product page [6]. The **dual-redundant design** refers to the ability to start the motor in two ways: under normal conditions the solid-state soft starter ramps the motor voltage, but if needed, an operator can bypass the electronics and connect the motor directly to full line voltage via the integrated bypass contactor **"at the flip of a switch,"** effectively providing an across-the-line starter as backup [1] [2]. This redundancy is invaluable in **mission-critical applications** – for example, in a production line or pump station where a failed start could cause costly downtime, the RX2E can switch to direct start mode to keep the motor running. Benshaw specifically markets the RX2E for **severe duty** and **critical applications** that cannot tolerate extended downtime [4].

Each RX2E unit comes with Benshaw's **MX2 intelligent motor control** technology at its core. The MX² control module provides precise digital control of the soft start/stop profile and includes built-in metering, diagnostics, and communication capabilities [2]. It also implements comprehensive motor protection functions (detailed in a later section) to safeguard the motor during operation. Programming and configuration can be done using the **door-mounted MX2 keypad** interface or via remote communication (Modbus RS-485), allowing integration with a plant control system or SCADA [7] [8]. In summary, the RX2E is an out-of-the-box solution that simplifies installation and commissioning for end-users: the **soft starter, protection devices, and operator controls are all factory-integrated** in one enclosure, reducing the engineering effort on site.

## Key Features and Design Highlights

The Benshaw RX2E softstarters offer a range of **features that enhance reliability, safety, and ease of use**. Below are some of the key design highlights and what they mean in practical terms:

- **Dual Redundant Starting Modes:** As mentioned, each RX2E unit can function as a **solid-state reduced voltage starter** for normal operation and can be switched to a **full-voltage starter** as an emergency backup. A selector (mounted inside the enclosure for safety) lets you choose between soft start or across-the-line start modes [9] [10]. In soft start mode, the RX2E's thyristor-based controller gradually ramps up the motor voltage, whereas in bypass mode the motor is connected directly to line (with an electromechanical contactor). This dual mode ensures that even if the electronic soft start circuitry is out of service, the motor can still be started to maintain operation – a critical advantage in processes where **continuous uptime** is required.

- **Integral Circuit Breaker with Shunt Trip:** Each RX2E includes a built-in **molded-case circuit breaker** (MCCB) as the main disconnect and short-circuit protection. The breaker is sized for the unit's horsepower (for example, a 250 HP unit has a 400 A breaker, while the 600 HP model includes a 1200 A breaker) [11] [12]. A **shunt trip** feature is provided on the main breaker [13], allowing the RX2E's controller or an external safety system to trip the breaker electrically in case of certain fault conditions – an important safety mechanism for fast disconnection during emergencies.

- **Full-HP Rated Bypass Contactor:** The RX2E's bypass contactor is not a small bypass only for the soft starter; it is a **fully rated AC3 contactor sized for the motor's full horsepower** and running current (with a 1.15 service factor) [10] [14]. This contactor serves two roles: (1) during a soft-start, it bypasses the SCR power electronics once the motor is up to speed, carrying the full load current with minimal losses; (2) it provides the direct-on-line starting path for the redundant mode. Because it's a heavy-duty contactor, it can carry the motor continuously and even be used for **across-the-line starting and running** when needed. The use of an integral bypass contactor also means reduced heat dissipation in the soft starter during normal run (since the SCRs can be bypassed after startup), allowing the RX2E to be built in **non-vented enclosures** without overheating [15].

- **Heavy-Duty SCR Power Stack:** The solid-state power devices in the RX2E are thyristors (Silicon Controlled Rectifiers) designed to handle **high current and voltage stress**. The RX2E series uses SCRs rated at **1800 PIV (Peak Inverse Voltage)**, meaning they can withstand surges and transients up to 1800 V, and they are UL-certified components [16]. The continuous current rating of the soft starter power stack is **125% of the motor full-load current**, underscoring its **continuous duty capability** for hard industrial use [17]. In terms of startup capacity, the RX2E soft starters are rated for **up to 500% of motor FLA for 30 seconds** for heavy starts [16]. This high current overload rating (five times the motor's normal current) allows the starter to handle demanding motor accelerations (for example, starting high-inertia loads or heavily loaded conveyors) without tripping. By contrast, standard-duty soft starters often are rated for 300–350% for 30 seconds; the RX2E's 500%/30s rating indicates a **true severe-duty design** built to start tough loads.

- **Door-Mounted Operator Interface:** For user convenience and safety, all routine controls are accessible on the enclosure door. This includes **Start and Stop pushbuttons**, a **Local/Off/Remote selector switch**, a **Reset** button for clearing overload trips, and indicator lights (e.g. a run indication lamp) [18] [19]. The **MX2 keypad** is also mounted on the door, featuring an LCD screen and navigation keys [7]. Through this keypad, users can program start/stop ramp settings, adjust protection setpoints, view motor electrical parameters (current, voltage, etc.), and diagnose faults – all **without needing to open the panel door**. This design meets safety standards and makes it easy to configure or operate the starter locally. For remote operation, terminals are provided inside the enclosure for wiring external start/stop commands, and an RS-485 port is available for communication to PLC/SCADA systems [8] [20].

- **Rugged Enclosure Options:** The RX2E series comes in **NEMA 12 or NEMA 3R enclosures** by default [3]. A NEMA 12 enclosure is intended for indoor industrial environments, providing protection against dust, dripping water, and oil/coolant seepage. NEMA 3R enclosures are rated for outdoors, protecting against rain, sleet, and external ice formation. The availability of a 3R outdoor-rated model means the RX2E can be installed in sheltered outdoor locations (for example, a pump station or a quarry site) without needing a separate indoor control room. An **optional NEMA 4** (watertight) enclosure is also offered for more demanding outdoor conditions or wash-down environments [21]. All enclosures are made of heavy gauge steel with quality powder-coat finish, suitable for **severe industrial environments**.

- **High Reliability and Warranty:** Benshaw emphasizes the RX2E's reliability with features like conformal-coated control boards (for resistance to humidity and dust) and built-in self-test diagnostics. In fact, the RX2E controls are part of Benshaw's *MX2* platform which carries a **three-year factory warranty**, notably longer than the industry standard of 12–24 months [22] [23]. This robust

warranty reflects confidence in the product's durability and is a significant benefit for customers. It reduces the total cost of ownership since any unlikely failures in the control electronics in the first three years are covered by Benshaw. Such a warranty period is indeed "industry leading," as one distributor notes [23], and it underscores the **rugged reliability** engineered into these soft starters.

## Technical Specifications and Range

**Electrical Ratings:** The Benshaw RX2E series is a **low-voltage** soft starter line, designed for three-phase systems with a nominal **line voltage of 480 VAC** (typical for North American industrial power). Standard models cover a wide horsepower range – approximately from **100 HP up to 600 HP** for 480 V motors. For example, Benshaw offers pre-engineered RX2E units at ratings like 100 HP, 125 HP, 200 HP, 250 HP, 400 HP and 600 HP (all at 480 V) [24] [12]. In terms of current, this corresponds to roughly **125 A up to 720 A** continuous current capacity (since a 600 HP 480 V motor draws about 720 A). Each model's main components (breaker, contactor, SCRs) are sized accordingly. For instance, the 250 HP unit is rated 302 A and uses a 400 A circuit breaker [1] [25], while the 600 HP unit uses a 1200 A breaker and heavier contactor to handle the ~720 A load [12].

**Control Power:** The RX2E includes a control power transformer (CPT) that steps the line voltage down to 110–120 VAC for the control circuit and MX2 controller power [26] [27]. This means the user typically does **not need a separate control power source**; you simply bring in the three-phase line to the starter, and the internal CPT provides the necessary control voltage for the contactor coils, MX2 electronics, and pilot devices. The CPT has primary and secondary fuses for protection [26]. The control circuit is usually 120 VAC (with options for 240 VAC control if needed), consistent with common industrial control practice and allowing easy interface to external 120 V signals if required.

**Motor Full-Load Amp Ratings:** To ensure proper overload protection and coordination, it's important to match the RX2E model to the motor's full-load amperage (FLA). Each soft starter model has a specific FLA range it supports. The integrated electronic overload (via MX2) is adjustable to the motor's FLA setting. Additionally, when running in bypass/emergency mode, the RX2E uses a **separately mounted overload relay (Benshaw "SPE" series)** in series with the motor [14] [28]. This dual-overload scheme ensures the motor is protected in both soft start and bypass scenarios: the MX2 handles overload protection during soft start ramps, and the standalone overload relay protects the motor during full-voltage run (when the soft starter SCRs are out of circuit). The overload relay is also classifiable – it can be set for various trip classes (Class 10, 20, 30, etc., or even up to Class 40) depending on the motor's thermal needs [29]. The MX2 controller allows separate "starting" and "running" overload curves, which is a sophisticated feature to avoid nuisance trips – e.g. a tighter limit during run but a higher threshold during the brief start period [29].

**Standards and Certifications:** The RX2E combination starters are **UL listed** and **cUL listed** (Canadian UL) as complete assemblies. The soft starter component meets UL 508 and IEC 60947-4-2 standards for motor controllers, and the enclosures meet NEMA/EEMAC specifications for their respective ratings. Benshaw literature notes compliance with **UL, cUL, and NEMA** standards on these units [30]. The SCR power modules, overload relays, and other internal components are also UL recognized. From a design standpoint, the RX2E includes features to meet relevant industrial standards and codes: for example, the provision of an **ANSI/IEEE 19** function (reduced voltage start) and many other ANSI protective functions (listed in the next section) shows alignment with IEEE device function codes for protective relays [31]. The controller also has built-in **self-test (BIST)** routines and is designed to meet **EMC and noise immunity** standards so that it can operate reliably in harsh electrical environments (high EMI, voltage disturbances, etc.).

**Physical and Environmental Specs:** Physically, a typical RX2E enclosure (for mid-range sizes) might have dimensions on the order of ~70 inches high, 30 inches wide, and 18 inches deep [32] [33], though larger horsepower units may have bigger enclosures to accommodate the larger breaker and contactor. The enclosures can be floor-mounted and usually include lifting eyes or brackets for handling. The operating temperature range is generally standard for industrial controllers (often 0 to 40 °C without derating, and possibly up to 50 °C with derating or forced ventilation – exact values would be in the user manual). Altitude above sea level may require current derating if installed at high elevations (per IEC guidelines). All RX2E units are painted with durable finishes to resist corrosion, and outdoor units have drip shields and gaskets appropriate for NEMA 3R. **Ingress protection** is essentially Type 12 or Type 3R as mentioned, not intended for wash-down unless upgraded to NEMA 4. Noise level is low since during run the unit is essentially just a quiet contactor (the SCRs don't continuously conduct once bypassed). Periodic maintenance on these starters is minimal – typically just verifying tightness of power connections and occasionally checking the contactor contacts and the cooling vents. The solid-state section has no moving parts and the MX2 control is microprocessor-based solid-state.

In summary, the RX2E series delivers heavy-duty electrical specs suitable for **starting large motors (up to 600 HP)** on 480 V systems, with all necessary control and protection built in. It conforms to industry standards and can be integrated readily into industrial power systems. Next, we will look at the comprehensive motor protection functions provided by the RX2E's control system.

## Motor Protection and Control Functions

One of the major advantages of the Benshaw RX2E softstarter is the **extensive motor protection** features embedded in its MX2 control platform. Unlike a simple across-the-line starter (which might rely only on a basic thermal overload relay), the RX2E's digital controller monitors multiple parameters and can trip or alarm on various abnormal conditions to protect the motor and the starter itself. These protection functions are implemented in line with standard industry practice, often corresponding to **ANSI/IEEE device numbers** for protective relays. The following are key protection and control functions provided, as documented by Benshaw [31] [29]:

- **Reduced Voltage Start (ANSI 19):** This is the fundamental function of a soft starter – applying a lower initial voltage to the motor and then ramping up, which **limits the inrush current and starting torque**. By doing so, it protects the motor's windings from the high thermal and mechanical stress of across-the-line starts and also avoids causing voltage sags in the facility. (While not a "fault protection", it's a control feature that significantly increases the lifespan of both the motor and connected machinery by easing the startup.)

- **Over/Under Voltage Protection (ANSI 27/59):** The RX2E monitors the supply voltage and can detect if the voltage goes too low or too high beyond set thresholds. Undervoltage can cause motor overheating or stalling, while overvoltage can stress insulation. The MX2 allows setting an undervoltage and overvoltage trip (each adjustable from 1% to 40% deviation, with a time delay of 0.1 to 90 seconds) [31]. If the supply stays outside acceptable limits for the set time, the RX2E will trip to protect the motor. This feature is often not available in older electromechanical starters, so it's a notable advantage for reliability – especially in facilities with weak power grids or frequent voltage fluctuations.

- **Undercurrent (Load Loss) Protection (ANSI 37):** Undercurrent or underload detection means the controller watches the motor current for a drop below a defined percentage of full-load. If the motor is supposed to be loaded (e.g. a pump pumping fluid or a conveyor carrying material) but suddenly the current falls significantly, it could indicate a mechanical failure like a broken belt, a pump running dry, or a loss of load. The RX2E can detect undercurrent (adjustable 5–100% of FLA, with delay 0.1–90 sec) and signal an alarm or trip [34]. This helps prevent damage from conditions like dry-running a pump (which could overheat the pump seals) by shutting down the motor quickly when a loss of load is detected.

- **Current Imbalance (Phase Unbalance) Protection (ANSI 46):** This function monitors if the three phase currents are imbalanced beyond a threshold (e.g. >5–40% imbalance). Current imbalance usually indicates phase loss, a blown fuse, or severe voltage imbalance upstream, and it causes motor overheating. The RX2E will trip if a significant current imbalance is detected [35]. Similarly, **Single-Phase protection** is included – if one phase is lost entirely, the imbalance becomes 100% and the unit will react promptly to save the motor from single-phasing.

- **Phase Rotation Monitoring (ANSI 47):** The controller can be set to check the phase rotation (phase sequence) of the incoming power. It can detect if the rotation is ABC, CBA, or if the system is single-phased. The user can select a setting to be sensitive to phase reversal or to be insensitive (if the application can tolerate either rotation) [36]. This is particularly useful during commissioning – ensuring the motor won't run in reverse due to a wiring mistake. In critical applications like pumps or fans, running backward could be dangerous, so the RX2E can lock out starting if the rotation is wrong.

- **Stall and Jam Protection (ANSI 48 & Mechanical Jam):** The RX2E implements an **up-to-speed timer (stall protection)** which will trip if the motor does not reach full speed within a programmed time (1 to 900 seconds) [37]. This protects against conditions where the motor might be stalled or overloaded during start (e.g., a seized load or excessive load inertia) – instead of drawing high current indefinitely and damaging the motor, the starter will shut it down after the allowed start time is exceeded. Additionally, a **mechanical jam** detection is provided (this is essentially a form of overload where the motor's running current suddenly spikes indicating something in the load has jammed). The combination of these prevents prolonged stall conditions that can quickly overheat motor windings.

- **Instantaneous Overcurrent Trip (ANSI 50):** If at any time the current exceeds a programmed threshold (e.g. 800% of FLA or a fixed multiple), the RX2E can immediately trip to protect against short circuits or severe faults [38]. Although a separate circuit breaker also provides short-circuit protection, the electronic trip can act faster for certain types of faults (and can be set more sensitively than the breaker in some cases). It essentially provides an **electronic "shear-pin"** function to disconnect the motor if something goes dramatically wrong (like a coupling failure or a locked rotor condition).

- **Thermal Overload (ANSI 51):** The RX2E provides electronic **motor overload protection** using thermal modeling. It supports adjustable trip classes from 1 to 40 and even separate dual settings for starting vs running [29]. This means the user can mimic a **Class 10, 20 or 30** overload relay or anything in between, matching the motor's thermal damage curve very closely – improving protection while avoiding nuisance trips. The thermal model will accumulate heating effect ($I^2t$)

during over-current conditions and trip when the safe limit is exceeded. A cool-down timer (or thermal memory) is usually included so that if a trip occurs, the starter won't allow immediate restart until the motor has sufficiently cooled (this prevents cumulative overheating). The ANSI 86 "lockout" function mentioned [39] likely refers to this overload lockout, which requires manual reset or a certain time before restart after an overload trip, ensuring safety.

- **Ground Fault (Residual) Protection (ANSI 50G/51G):** The RX2E can detect ground fault currents by monitoring the imbalance of currents in the three phases (residual current). If a ground fault above a threshold (adjustable 5–100% of FLA) is detected, it can trip the starter [40]. Low-level ground faults might not blow a fuse but can cause motor core damage or fire risks, so this feature adds a layer of protection especially for high-powered motors where ground faults need quick clearing. Note that this is sensing on the low voltage side; it's meant for ground leakage and not as a substitute for a large ground fault relay in high-resistance grounded systems, but it is effective for equipment protection.

- **Over/Under Frequency (ANSI 81):** The controller can also monitor the line frequency and detect if it strays outside limits (e.g. if generator power is used or a major grid disturbance). Over/under-frequency protection [41] is less commonly needed in stable utility-fed systems, but it's useful in scenarios with generator backup or in marine/offshore applications. It ensures the motor isn't running at unacceptable frequency that could cause flux and heating issues.

- **Alarm Outputs (ANSI 74):** The RX2E provides an alarm relay (configurable) [42] which can be used to signal a warning condition without tripping. For example, you might set an alarm if the motor current is above 90% for a prolonged time (approaching an overload) or if power factor is low, etc., to alert maintenance before an actual trip occurs. The presence of an alarm relay (ANSI 74 function) allows proactive maintenance and is also often tied into SCADA systems to notify operators of issues.

- **SCR Monitoring and Self-Test:** In addition to motor-focused protections, the RX2E monitors its own power electronics. It includes **shorted SCR detection** [43] – if one of the thyristors were to fail shorted, the unit would detect that condition (likely by sensing current flow when there should be none) and could inhibit a start to avoid an uncontrolled full-voltage application. The system also likely checks for open SCRs or firing circuit issues (sometimes called diagnostics or BIST – built-in self test). This ensures the soft starter is healthy to perform a proper controlled start.

- **Advanced Ramp Control:** On the control side, the MX2 allows customization of the **motor's acceleration and deceleration profiles**. Users can select different ramp types – for instance, a **voltage ramp** vs. a **current limit start**. Current limit mode can be useful to cap the maximum current during start to a set value (the RX2E's 500% rating means it can allow very high current if needed, but one might choose to limit to a lower level to reduce mechanical stress, at the cost of a longer ramp time). The MX2 also includes an **adjustable soft stop (voltage ramp-down)** which is particularly beneficial for stopping pumps to reduce water hammer shock [44]. In fact, Benshaw notes that the RX2E provides "adjustable voltage control deceleration suitable for pumping applications" [44]. This feature gradually reduces voltage to let a pump decelerate gently, as opposed to slamming to a stop. It mirrors the kind of functionality found in specialized pump controllers – for example, **ABB's PSTX soft starters use torque control to achieve a soft pipe fill and eliminate water hammer on pump stop** [45]. With the RX2E, an operator can tailor the decel ramp time so that fluid dynamics in pipes are managed to avoid pressure surges.

- **Communications and Metering:** The RX2E's MX2 controller also acts as a meter and communications interface. It measures line currents, voltages, power factor, etc., and can communicate data via **Modbus RTU (RS-485)** as a standard feature [20]. This means the soft starter can report the motor's current, thermal capacity used, running hours, number of starts, and trip statuses to a central system. For modern IIoT or plant automation, having these data helps with predictive maintenance. An optional **expanded communications module (MXDE3)** can be added to support protocols like Ethernet/IP, Profibus, or others if needed (according to Benshaw's brochure) [30]. In essence, the RX2E can function as a smart motor control center bucket – providing both control and a stream of operational data.

Overall, the RX2E serves not just as a starter but as a **complete motor protection relay** combined with a soft starter. It offers many of the same protective features one would expect from a dedicated motor protection unit or VFD. This comprehensive protection package helps **extend the motor's lifespan and increase system reliability**, as it guards against both electrical issues (voltage, current anomalies) and mechanical issues (jam, load loss) that could otherwise go unchecked. As an example of the effectiveness: a recent engineering study comparing direct-on-line vs soft starter operation found that soft starters significantly **reduce startup transients and mechanical wear**, making them a "superior choice in applications where reducing start-up stress is critical" [46]. By controlling the voltage ramp and monitoring motor conditions, the RX2E prevents the sudden jolts and high currents that a DOL starter would impose, thus **minimizing wear on gears, belts, and the motor itself**. Additionally, soft starters can bring motors to speed faster in some cases with less oscillation – the referenced study noted a soft starter achieved a stable run in 0.2 seconds vs 0.4 seconds for a direct start in a test case [47], illustrating the smoother acceleration profile.

To summarize, the RX2E's motor protection features are on par with advanced motor control devices in the industry. They ensure that both the motor and the soft starter are **actively protected** during operation, thereby reducing unplanned downtime. These protections, combined with the ability to record and communicate events, also help maintenance teams troubleshoot issues quickly (for instance, the RX2E will log if a trip was due to overload, undervoltage, etc., which can be viewed on the keypad or via software). This level of insight and protection is a significant improvement over traditional electromechanical starters.

## Benefits and Applications in the Field

Adopting a soft starter like the Benshaw RX2E yields numerous benefits for motor-driven systems. Here we highlight how the RX2E helps **solve common motor starting problems** and improves operations, along with example use cases across industries:

- **Reduced Mechanical Stress on Equipment:** One of the primary advantages of soft starters is the gentle application of torque. By ramping up motor speed gradually, the RX2E minimizes the mechanical shock to couplings, belts, chains, and gearboxes. In high-inertia systems (like bulk material conveyors or rock crushers), direct across-the-line starts can be brutal – belts may slip, tension spikes occur, and gear teeth slam together. Soft starters eliminate the sudden jerks. For example, in aggregate processing plants, using soft starters on crushers and conveyor belts **prevents belt slippage and excessive tension**, thereby extending belt and pulley life [48] [49]. Similarly, for large centrifugal fans or blowers, a soft start reduces stress on the impeller and drive components, avoiding the "hammering" effect of full torque instantly. Over time, this translates to **lower maintenance costs and less downtime**. Plant Engineering notes that after upgrading to soft

starters, facilities often see a **reduction in maintenance needs** – motors run more smoothly and there is less wear on contactors and mechanical parts, resulting in fewer replacements and repairs [50]. All of this contributes to improved equipment longevity and reliability.

- **Mitigation of Electrical Stress and Voltage Drops:** When a large motor starts across the line, it can draw 6 to 8 times its full-load current. This surge not only stresses the motor windings but can cause a significant **voltage sag** in the supply, affecting other equipment. In contrast, the RX2E soft starter keeps the inrush current under control (often you can limit it to around 2-3 times full-load current or as needed). This has a twofold benefit: it **prevents overheating of the motor** (since the $I^2t$ stress is greatly reduced) and it **protects the facility's electrical network** from heavy dips. In industries with weak power infrastructure or when starting multiple large motors, this is crucial. For instance, in a rural water pumping station running on a generator, a soft starter can mean the difference between a smooth pump start or a generator overload. Soft starters also reduce **power surges** that can flicker lights or disturb sensitive equipment in the plant [51]. By easing the motor into operation, the RX2E effectively **improves power quality** and can even cut down on peak demand charges from utilities, since it avoids the massive spikes that trigger higher demand readings.

- **Enhanced Process Control – Especially for Pumps:** The RX2E's ability to perform soft stopping (soft deceleration) is particularly advantageous in pumping applications. Water hammer is a notorious issue when pumps stop suddenly – the kinetic energy of moving water translates into pressure spikes that can burst pipes or damage valves. With the RX2E, an operator can program a ramp-down of a few seconds to let the pump slow gradually, thus **avoiding water hammer**. This concept is widely embraced in industry: for example, ABB's water industry soft starters use torque control to similarly provide a "soft pipe fill" and gentle stop, greatly reducing pressure transients [52] [45]. By deploying the RX2E on pumps, **pipeline and valve life is extended** and maintenance due to pressure surges is minimized. Additionally, the RX2E can incorporate a **pump cleaning/jog feature** (as some smart starters do) to momentarily run the pump in reverse or at slow speed to clear clogs, although this particular feature may be more relevant to VFDs or specialized controllers. Nonetheless, even the standard soft start/stop and underload protection in the RX2E help prevent scenarios like dry running (which triggers undercurrent alarms) or excessive pressure buildup. In sum, using RX2E soft starters on pumps in water/wastewater facilities leads to smoother operation of the system and fewer disruptive events.

- **Critical Application Uptime via Redundancy:** The dual redundant design of the RX2E directly addresses a common concern in industrial operations: **maximizing uptime**. Consider a mining operation running a conveyor transporting ore – if the motor starter fails, the conveyor is down and production halts, incurring significant costs. With a traditional soft starter, a fault in the SCRs or control would mean the motor can't be started until repairs. However, the RX2E provides a built-in contingency: if the soft start mode is unavailable, the operator can switch to the bypass (across-the-line) mode and get the motor running immediately. This is a huge benefit in scenarios where **every minute of downtime is costly** (mining, cement plants, steel mills, etc.). It effectively means the RX2E unit has no single point of failure that can completely prevent motor operation – a failed electronic component can be circumvented by using the mechanical starter path. Users in process industries (chemical, oil & gas) where processes must continue, or in **continuous process manufacturing**, highly value this capability. In fact, Benshaw's RX series (including medium voltage versions) have been adopted in such industries specifically for this reason – the "unique, dual redundant design" is touted as *ideal for applications where downtime is extremely disruptive* [2]. Beyond the hardware

redundancy, Benshaw also supports these critical users with rapid service and a stock of replacement units (their **Fast Track** program, as indicated by tags like "Fast Track" on the product) [53], meaning an RX2E can be shipped quickly if needed. The bottom line is that RX2E soft starters help **maintain production continuity** and provide peace of mind that a motor failure to start can be resolved in short order.

- **Energy Savings in Fixed-Speed Systems:** It's worth noting that while soft starters themselves do not significantly save energy during running (unlike variable frequency drives which can reduce speed to save energy), they do eliminate the wasteful inrush peaks and can slightly reduce the heat dissipation during startup by managing current. More importantly, by allowing **use of the integrated bypass contactor**, the RX2E ensures that once the motor is at full speed, the SCRs are not dropping voltage continuously – the motor runs at full efficiency as if on the line. Some older soft starters without bypass would impose continuous voltage drop and heat losses, but the RX2E avoids that. Additionally, by preventing dips and spikes, overall system efficiency and power factor might be improved indirectly. In certain applications, a soft starter can allow a system to use a smaller backup generator or avoid utility penalties, which is a kind of energy/cost saving. And of course, the **reduced mechanical wear** translates to **energy saved in maintenance and downtime** – a soft starter "pays for itself very quickly" in maintenance reduction, as one industry article notes, because you spend far less on replacing damaged parts and dealing with outages [54] [55].

- **Use Cases Across Industries:** The RX2E's flexibility and robust design make it suitable for a wide array of industries:

- **Manufacturing and Processing:** Fans, blowers, compressors, mixers, and large pumps in factories can use RX2E starters to avoid mechanical shocks and electrical issues. For example, a large dust-collection fan motor started with an RX2E will ramp up without belt slip and with lower line disturbance. In a compressor, a soft starter can alleviate the high starting torque that might otherwise strain the compressor and motor coupling.
- **Mining/Aggregates:** As discussed, crushers, mills, and conveyors benefit greatly. Soft starters can increase uptime for rock crushers by reducing the start torque that often causes jams or stress fractures. Conveyors with multiple sections can be started sequentially with soft starters to avoid belt stress. Benshaw's own case archives mention applications like **ball mills** and **aggregate crushers**, where reliable starting and the ruggedness of controls are crucial [56] [57].
- **Water/Wastewater:** Huge pumps and blowers in water treatment plants often require gentle starting to protect pipelines and to manage generator load. The RX2E in a wastewater pump station would ensure pumps start without surges, and the soft stop prevents hammer when stopping large pumping units. Also, the corrosion-resistant enclosure options and the MX2's metering (which can track pump running hours, etc.) are valuable for utility operators.
- **Oil & Gas, Marine:** In hazardous areas or remote locations, the reliability of the starter is critical. RX2E can be part of API-rated systems (with appropriate purged enclosures or installed in safe areas driving explosion-proof motors). On offshore platforms or marine vessels, where power systems are isolated, soft starters help manage the limited power generation capacity (so a large winch or thruster motor can be started smoothly without dimming the lights or overloading the generator). The **all-compatible** nature of modern soft starters is emphasized by major manufacturers – for example, ABB's "all-compatible" portfolio where once you know one device interface, you can use others [58]. Benshaw's MX2 is similarly designed to be user-friendly in various scenarios.

- **HVAC and Refrigeration:** Chillers and large compressors in HVAC systems often use soft starters if variable speed drives are not needed. The RX2E can handle the high starting torque of compressors while protecting the electrical network in a large facility like a hospital or data center. Also, building codes sometimes require reduced-voltage starting for very large motors to mitigate line disturbances; the RX2E provides a compliant solution in such cases.

In all these applications, the **common theme** is that the Benshaw RX2E softstarter provides *smooth control* and *robust protection*. By solving issues like high inrush current, mechanical jerks, and lack of backup starting methods, it **helps customers avoid equipment damage and operational interruptions**. The result is increased productivity and lower lifetime costs. A soft starter is an investment that often **pays for itself quickly**, as noted in an engineering publication, through reduced maintenance and improved uptime [50] [59]. The RX2E, with its heavy-duty design, is particularly geared to maximize these returns in harsh and critical duty contexts.

## Industry Context and Comparisons

Soft starter technology is a well-established solution in motor control, and many leading manufacturers offer their own lines of soft starters comparable to Benshaw's RX2E series. Companies like **ABB, Siemens, Schneider Electric, Eaton, Rockwell/Allen-Bradley, WEG, and others** have soft starter products covering similar voltage and horsepower ranges. For example, ABB's popular PSTX series soft starters (rated up to 1250 A) include features like built-in bypass, motor protection functions, and even specialty pump controls [60] [45], much like the RX2E's offering. Eaton's **S811/S801** starters and Schneider's **Altistart** series likewise provide reduced-voltage starting with electronic control, aiming to reduce mechanical wear and electrical stress. This broad adoption across manufacturers highlights that **soft starters are a standard best-practice solution** for fixed-speed motor applications that require gentler starting than direct-on-line. In fact, the global market for soft starters has been growing, as industries continue to modernize older starter systems with solid-state solutions for better efficiency and equipment care [61] [62].

However, within this competitive landscape, the **Benshaw RX2E has some unique differentiators** that make it stand out:

- **Dual Redundant Design:** Not all soft starters in the market emphasize the dual redundancy feature the way Benshaw does. Many soft starters include a bypass contactor for efficiency, but few package the system such that the bypass can be used as an emergency full-voltage starter with a flick of a switch. Benshaw has effectively combined a traditional electromechanical starter and a soft starter into one unit. In contrast, a typical competitor's soft starter might rely on the user to have an external bypass or a manual way to run the motor if the soft starter fails. Benshaw's integrated approach simplifies this – it's a **single product that inherently provides two starting methods**. This is especially appealing to customers in heavy industries and is a result of Benshaw's focus on **"severe duty" and "mission critical" solutions** [4]. Even within Benshaw's own product family, this approach is extended to higher power ranges (for instance, their medium-voltage **RX3E/RX4E** series for thousands of HP have similar redundant configurations [63]). This sets Benshaw apart as a specialist in **high-reliability motor starters**.

- **Heavy-Duty Performance and Warranty:** Benshaw's soft starters, historically influenced by both American and international (AuCom) designs, are known for being conservative in ratings. The RX2E's 500% at 30 s heavy start rating is somewhat above the norm, which gives extra starting

capability. Additionally, the **3-year warranty** and the claim of "industry leading" support [23] suggest Benshaw is confident in real-world durability. While other brands also have high-quality offerings (ABB PSTX, for example, is also high-end and feature-rich), not all competitors match that standard warranty period. This can be a deciding factor for some customers looking at total cost and risk – a longer warranty can reduce risk. Benshaw also provides strong technical support and field service (being a more specialized player in motor controls), which can be a contrast to larger conglomerates where support might be more generalized.

- **Ease of Integration and Use:** The RX2E's use of the MX2 control platform with a **consistent user interface** across Benshaw's low voltage lineup means once an engineer is familiar with one Benshaw starter or drive, they can navigate others easily. The **all-in-one nature** (with built-in CPT, breaker, etc.) simplifies panel design for OEMs or system integrators. Some other brands offer chassis soft starters that then require external breakers, transformers, pilot devices – which gives more flexibility but also more assembly work. Benshaw's approach with the RX2E is more turnkey. For certain customers (say an end-user who just wants to replace an old starter bucket), the RX2E can drop in with minimal additional components needed. Furthermore, features like **Modbus communication standard** make integration straightforward, whereas some competitors might require add-on modules for communications. Of course, in large facilities with multiple vendors, these differences might be minor, but for a single-source project, the RX2E can reduce the part count and wiring significantly.

- **Multiple Manufacturers, Similar Solutions:** It's worth acknowledging that the concept of soft starting is widely applied. **ABB, Hitachi, Eaton, Yaskawa, and Lenze** are all major players in motor control and each provides solutions to address starting currents and mechanical stress. For instance, Hitachi and Yaskawa (more famous for drives) also recognize the need for soft starters in fixed-speed contexts where drives aren't necessary; Eaton's soft starters include features like voltage ramp and current limit similar to Benshaw's; Lenze (known for automation) also offers motor starter drives for smooth starting. The RX2E's feature set aligns with industry trends: almost all modern soft starters offer microcontroller-based motor protection, some form of communication, and energy-saving bypass contactors. The **difference often comes in specific features or niches** – Benshaw targets the high end of robustness and redundancy, ABB PSTX targets advanced motor/pump functionalities with a lot of bells and whistles (like torque control and built-in daily schedulers, etc.), Schneider's Altistart may focus on simplicity and cost-effectiveness, and so on. From a customer perspective, having multiple reputable manufacturers in this space is a good thing: it validates the importance of using soft starters to solve motor starting issues. As a result, many industries now treat soft starters as the default for motors above certain sizes, unless a VFD is required for speed control.

In summary, the **Benshaw RX2E series holds its own among top-tier soft starters** by providing a blend of heavy-duty reliability, comprehensive motor protection, and a unique redundancy advantage. It reflects a deep understanding of end-user needs in critical applications. When evaluating soft starters, users will often compare specs like current ratings, features, and cost across these manufacturers. The RX2E tends to appeal to those who need something a bit more rugged or specialized, as opposed to purely cost-driven applications (for which Benshaw also has simpler lines, and competitors have economy models). By combining the roles of a soft starter and a contingency DOL starter, the RX2E offers **peace of mind** that's particularly valued in sectors where unplanned downtime or a failed start could have serious consequences.

## Best Practices for Implementation

To maximize the benefits of the Benshaw RX2E softstarter, here are a few **practical tips and best practices** when implementing this equipment:

- **Proper Sizing and Model Selection:** Always choose an RX2E model that matches or exceeds the motor's full-load amperage and service factor requirements. Consider the application's starting profile – for instance, a high-inertia load that takes a long time to accelerate may require using the RX2E's full heavy-duty capability (500% for 30 s). If your start time will exceed 30 seconds at high current, consult Benshaw for a possible larger unit or alternative solution. It's also important to verify the **duty cycle**: if the motor will be started frequently (many starts per hour), ensure the soft starter can handle the thermal load. The RX2E's thermal modeling can help here, and Benshaw can provide guidelines for starts per hour based on motor size.

- **Setting the Optimal Ramp Profiles:** Take advantage of the MX2's configurable soft start and soft stop settings. For example, if you're controlling a pump, you might program a **longer soft stop ramp** to mitigate water hammer, as discussed earlier. If you're starting a conveyor with material on it, a **current limit start** might be preferable to prevent belt slip – you can set the current limit to, say, 300% and let the conveyor take a bit longer to get to speed, rather than a voltage ramp that might cause an initial surge. The RX2E allows fine-tuning of **initial torque** (initial voltage) and **ramp time**. A good practice is to start with conservative settings (longer ramp, lower initial torque) and then adjust upward as needed to achieve an acceptable start time without tripping. The goal is a smooth acceleration with no stalls and minimal mechanical stress. Similarly, adjust the **deceleration (soft stop)** carefully – too long a decel on certain loads could cause the motor to act as a generator; too short defeats the purpose. Benshaw's support can provide typical settings for common applications as a starting point.

- **Utilize Protective Setpoints:** The RX2E has many protections, but they only help if enabled and correctly set. When commissioning, be sure to program the **motor FLA and service factor** into the controller. Set the **overload class** appropriate to your motor (e.g., Class 20 for standard motors, Class 30 for high inertia if needed). If the application can benefit from it, enable the **undercurrent protection** (for example, in a pump to detect dry run) and set it a bit below the normal running current. Likewise, set an **overcurrent trip level** above the starter's normal range but below what you think would indicate a severe problem – this can protect against faults faster than the breaker. Use the **voltage protection** if your site has issues with brownouts or surges – you might set undervoltage trip at ~85-90% and overvoltage at ~110% with a short delay, so the motor will shut down gracefully in case of supply issues (preventing things like contactor chatter or motor overheating under low voltage). Remember to also set the **phase rotation** to the desired value (typically ABC). If you ever need to change motor leads and flip rotation, update the setting or disable it temporarily to avoid a nuisance trip. Essentially, treat the RX2E as you would a protective relay – configure each relevant function to suit the motor and process needs.

- **Integration and Control Wiring:** When wiring the RX2E into your control system, decide whether it will be operated locally (via the door buttons) or remotely (via PLC or control room). The RX2E has a **Local/Remote selector** on the door – in Remote mode, the start/stop commands are taken from the terminal strip or communications. Make sure your PLC's outputs are properly interlocked (for example, if using Modbus, ensure only one control source is active at a time). If you plan to use the

Modbus communication for control or monitoring, test the connectivity and mapping during commissioning – read back motor currents, status, etc., to confirm all is communicating correctly. The RX2E provides a wealth of data, so integrating that into your SCADA (like showing the motor current, or an alarm on a soft starter trip) can greatly help operators. For remote start/stop via dry contacts, use the provided terminal strip connections; ensure any field stop buttons or E-stops in series are accounted for, to maintain the functionality of stopping the starter under emergency conditions. Also, if you need an **Emergency Start bypass** (to force direct-on-line mode), establish a procedure or wiring such that only authorized use is allowed – typically it might be a physically keyed switch inside the panel to toggle solid-state vs bypass mode.

- **Thermal Management and Maintenance:** Even though the RX2E is designed for non-vented enclosures (thanks to the bypass contactor reducing SCR heat), it's wise to check the enclosure temperature if the starter is in a confined space. Ensure there is some clearance around the enclosure for cooling. In NEMA 12 installations, if the environment is very hot, consider adding a fan or cooler, or at least monitoring the MX2's temperature reading (if available). During periodic maintenance, **blow out any dust** from the enclosure (with control power off) to keep the electronics clean. Check that contactor contacts aren't excessively worn if the bypass is often opening/closing (though under normal conditions, the bypass closes once per start so wear is minimal). Verify the breaker is operational and not tripped (the shunt trip or UV release if used can be tested). The MX2 might have self-diagnostic logs; it's good to review if there were any warnings (like a history of undervoltages or overload alarms) which could indicate an upstream or load issue to address. In short, while the RX2E doesn't require much maintenance, giving it a look at regular intervals will ensure it runs for many years without issue.

- **Coordination with Other Protection:** If the RX2E is part of a larger system with upstream fuses or downstream devices, coordinate the settings. For example, if there are fuses feeding it, ensure their rating allows the short-duration 500% inrush. The RX2E's internal breaker will handle most faults, but you might have an **upstream feeder breaker** – set that such that it doesn't trip before the RX2E's own breaker or protection acts (selective coordination). On the downstream side, if the motor has something like a thermal sensor (PTC thermistor in windings), you might integrate that to the RX2E's fault input if possible (some soft starters have an input for thermistor – Benshaw's MX2 may have configurable inputs that could be used for an external trip). Using all available protections in tandem provides the best safety net.

By following these practices, users can ensure they fully leverage the RX2E's capabilities. The goal is not only to install a reliable soft starter, but to integrate it in a way that **optimizes motor performance and protection** for the specific application. When properly applied, the Benshaw RX2E will deliver smooth motor control and robust protection for many years, with minimal intervention – truly embodying a "install and relax" solution for tough motor control challenges.

## Conclusion

The Benshaw RX2E series combination soft starters represent a **state-of-the-art solution** for controlling and protecting large electric motors. By blending solid-state soft starting with traditional electromechanical backup and comprehensive electronic protection, the RX2E addresses the full spectrum of motor starting challenges. It provides **smooth acceleration and deceleration**, which translates to fewer mechanical breakdowns and lower maintenance in machinery [64] [50]. It drastically **cuts down electrical stress**,

avoiding the voltage dips and peak currents that can plague direct starters. And uniquely, it offers the **assurance of redundancy** – a built-in "plan B" to keep critical operations running if anything goes wrong with the soft start path [2].

In practical terms, adopting the RX2E can help customers **solve persistent problems**: pumps no longer slam to a stop causing water hammer; conveyor belts start without slipping and overheating; production lines don't unexpectedly trip breakers on motor starts; and maintenance crews find motors and starters running cooler and lasting longer. The integrated motor protection features act like a vigilant guardian, constantly monitoring for conditions that could harm the motor and intervening when necessary to prevent damage. This means fewer catastrophic failures and more controlled shutdowns, which in an industrial environment is the difference between a quick fix and a major repair. Real-world users have seen that soft starters "**reduce the need for maintenance**" and virtually eliminate certain failure modes associated with hard starting [50] – an observation that underscores why so many facilities are retrofitting older starters with modern soft start units.

Moreover, Benshaw's attention to heavy-duty design (evidenced by high current ratings, UL listings, and that confident 3-year warranty) gives peace of mind that the RX2E can endure harsh conditions – whether it's the dusty heat of a mining site or the high starting frequency of a marine cargo winch. The RX2E isn't an experimental new gadget; it's built on proven technology (MX2 control platform) and aligns with industry standards and practices that have been honed over decades of motor control experience. In essence, it is a **mature and reliable product** that integrates cutting-edge controls with rock-solid power components.

From an ROI perspective, while a soft starter is an upfront investment, the **savings from reduced downtime and extended equipment life are substantial**. As one industry expert noted, the benefits of soft starters – reduced power consumption during starts and lessened maintenance – mean they often pay for themselves quickly and continue to provide returns long after [65] [59]. The RX2E, by minimizing both electrical and mechanical strains, exemplifies this value proposition. It helps facilities avoid the hidden costs of direct starting (like replacing cracked shafts or dealing with power quality fines) and instead promotes a more **controlled, efficient operation** of motors.

In conclusion, the Benshaw RX2E softstarter is more than just a motor starter – it is a **holistic motor management system** that encapsulates safe starting, operational flexibility, and intelligent protection. For engineers and operators seeking a dependable solution to start big motors smoothly and keep them running reliably, the RX2E series is a compelling choice. It combines the best of both worlds (solid-state smarts and electromechanical muscle) into one package. By implementing such advanced soft starters, industries can achieve higher productivity, greater electrical efficiency, and improved longevity of their critical motor assets – all of which contribute to a better bottom line and a safer, more stable operation. The RX2E truly helps "take the stress out of motor starting," allowing complex industrial processes to run with fewer hiccups and more peace of mind.

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