Intelligent Low Voltage Solid State Motor Control Products

with next generation {MX}² / {MX}³ technology

Mission critical reliability
Patented soft start technology
Integral digital protection and metering
Continuous and integral bypass chassis
RXE redundant configurations
MXP modular, prepackaged starters
Reversing, two-speed, wound rotor
Synchronous, dc injection braking
24/7 service and support
MX² Control Highlights

The MX² control technology from Benshaw provides a powerful, flexible, intelligent low voltage motor control platform. MX²-based controls offer multiple, user selectable starting modes, an increased selection of configurable digital and analog I/O’s, comprehensive built-in metering capabilities, unprecedented onboard protection and an easy to use, intuitive user interface.

Our control board terminal configuration—coupled with programmable burden CT settings—makes Benshaw’s MX² technology an excellent choice for a wide range of intelligent, soft start motor control applications.

Benshaw’s MX²-based low voltage motor controls raise the bar for intelligent, low-cost, soft start motor control.

When you factor in our unique three-year factory warranty and 24/7 comprehensive technical support, we think you’ll find Benshaw’s MX²-based controls to be an excellent value.

Standard Features:

• High performance motor control with multiple starting modes built in
• Jogging 7 and 14% speed
• 3 user configurable digital inputs
• 2 fixed inputs for start and bypass confirm
• 3 user configurable output relays and 1 fixed bypass confirm
• User configurable analog I/O
• Programmable burden CT settings
• Residual ground fault
• Advanced line / motor metering
• DC braking light duty
• Power stack thermistor
• Data snapshot of each fault
• Power up on start
• 1,000 V capable
• Energy saver
• Remote keypad ready
• UL, CUL, NEMA compliance
• Built-in self-testing (BIST)
• Modbus 485 plus expanded communications capabilities with optional MXDE3 communications module
**MX² Control Features**

### Multiple Starting Modes:
- Voltage ramp
- Current ramp
  - Adjustable initial current
  - Adjustable maximum current
  - Adjustable ramp time
- Torque ramp (TruTorque™)
  - Adjustable initial torque
  - Adjustable maximum torque
  - Adjustable ramp time
- Power ramp
  - Adjustable initial torque
  - Adjustable maximum torque
  - Adjustable ramp time
- Linear/tach feedback control
- Jogging 7 and 14% speed

### Motor Protection:
- Motor thermal overload
- Independent starting and running OL's
- Up to speed timer exceeded
- Low line voltage
- Low line frequency
- High line frequency
- Phase reversal
- Phase loss
- Instantaneous overcurrent
- Overcurrent
- Undercurrent
- Current imbalance
- Ground fault residual
- Shorted SCR
- Disconnect fault
- Inline contactor fault
- Control power low
- Stack over temperature

### Metering:
- +/- 2% accuracy
- Average current
- L1 current
- L2 current
- L3 current
- Current imbalance %
- Ground fault amps/residual
- Average volts
- L1–L2 voltage
- L2–L3 voltage
- L3–L1 voltage
- Overload %
- Power factor
- Watts
- VA
- VARS
- KW hours
- MW hours
- Phase order
- Line frequency
- Analog input
- Analog output
- Run time — days
- Run time — hours
- # of starts
- TruTorque™ %
- Power %
- Peak starting current
- Last starting duration

### 3 Digital Inputs
- Configurable to:
- Stop
- Fault
- Fault reset
- Bypass/confirmation & inline
- OL reset
- Local/remote selection
- Heater enable
- Heater disable
- Dual ramp selection
- 1 dedicated start input
- 1 dedicated bypass

### 3 Relay Outputs
- Configurable to:
- Starter off
- Faulted fail safe and non fail safe
- Running
- Up to speed
- Alarm condition
- Ready condition
- Locked out
- Over current trip
- Under current trip
- OL alarm
- Shunt trip fail safe and non fail safe
- Ground fault
- Energy saver indication
- Heating indication
- Slow speed forward/reverse
- DC braking
- Cooling fan
- 1 fixed bypass

### 1 Analog 4–20 mA / 0–10 Vdc Output
- Configurable to:
  - Current (0–200%/0–800%)
  - Voltage (0–150%)
  - OL (0–150%)
  - KW (0–10 Kw/0–100 Kw)
  - MW (0–1 Mw)
  - Analog input (0–100%)
  - Firing (0–100%)
  - Calibration

### User Interface:
- Standard board-mounted LED interface
- Optional remote mount LCD display
  - Set/examine operating parameters
  - View status information
  - View line current, voltage and frequency in real time
  - Start and stop the solid state starter

### 1 Communication Port
- Included:
  - Modbus RTU / RS485

### Optional with MXDE3:
- DeviceNet
- EtherNet
- EtherNet/IP
- Modbus TCP

### Advanced Functionality:
- Dual ramp selection
- Adjustable kick current
- Programmable decel modes
- LV BIST test (built-in self test)
MX³ Control Highlights

Benshaw’s next generation MX³ technology propels low voltage motor control to even greater levels of performance and functionality. With its real-time clock, enhanced programming capabilities, ease of use, and a unique, flexible architecture—Benshaw’s MX³ controller delivers advanced motor control and protection with all of the rugged, dependable performance you’ve come to expect from a world leader in advanced controls and drives.

MX³ controllers, power components, software and sensors are all designed, built and tested to perform as an integrated control system, eliminating the coordination and performance problems inherent in other forms of reduced voltage starting.

Benshaw’s next generation MX³ technology will shorten your commissioning times, improve motor performance and protection, enhance diagnostic capability and streamline electrical system monitoring and maintenance tasks.

Benshaw’s MX³ control technology provides all MX² features, plus:

- 8 user configurable inputs
- 2 fixed inputs for start and bypass confirm
- 6 user configurable relay outputs
- 1 fixed output for bypass confirm
- Real-time clock
- Motor PTC input
- Zero Sequence Ground Fault
- RTD module support
- Full DC braking with add-on SCR
- Event log (99 events)
- Start per hour limiter
- Back spin timer
- Time between starts limiter
- Zero speed switch input
- Power outage ride through (PORT)
- Power factor trip
- Patented Cyclo™ control (0-40% speed)
Multiple Starting Modes:
- Voltage ramp
- Current ramp
  - Adjustable initial current
  - Adjustable maximum current
  - Adjustable ramp time
- Torque ramp (TruTorque™)
  - Adjustable initial torque
  - Adjustable maximum torque
  - Adjustable ramp time
- Power ramp
  - Adjustable initial torque
  - Adjustable maximum torque
  - Adjustable ramp time
- Linear/tach feedback control
- Cyclo™ converter control

Motor Protection:
- Motor thermal overload
- Independent starting and running OLs
- Up to speed timer exceeded
- Low line voltage
- Low line frequency
- High line frequency
- Phase reversal
- Phase loss
- Instantaneous overcurrent
- Overcurrent
- Undercurrent
- Current imbalance
- Ground fault (residual or zero sequence)
- Shorted SCR
- Disconnect fault
- Inline contactor fault
- Control power low
- Stack over temperature
- Motor PTC input
- RTD modules

Metering:
- +/- 2% accuracy
- Average current
- L1 current
- L2 current
- L3 current
- Current imbalance %
- Ground fault amps/residual
- Average volts
- L1–L2 voltage
- L2–L3 voltage
- L3–L1 voltage
- Overload %
- Power factor
- Watts
- VA
- VARS
- KW hours
- MW hours
- Phase order
- Line frequency
- Analog input
- Analog output
- Run time — days
- Run time — hours
- # of starts
- TruTorque™ %
- Power %
- Peak starting current
- Last starting duration
- Real-time clock

6 Digital Inputs
Configurable to:
- Stop
- Fault
- Fault reset
- Bypass/confirmation & inline
- OL reset
- Local/remote selection
- Heater enable
- Heater disable
- Dual ramp selection
- 1 dedicated start input
- 1 dedicated bypass

6 Relay Outputs
Configurable to:
- Starter off
- Faulted fail safe and non fail safe
- Running
- Up to speed
- Alarm condition
- Ready condition
- Locked out
- Over current trip
- Under current trip
- OL alarm
- Shunt trip fail safe and non fail safe
- Ground fault
- Energy saver indication
- Heating indication
- Slow speed forward/reverse
- DC braking
- Cooling fan
- 1 fixed bypass

1 Analog 4–20 mA / 0–10 Vdc Output
Configurable to:
- Current (0–200%/0–800%)
- Voltage (0–150%)
- OL (0–150%)
- KW (0–10 Kw/0–100 Kw)
- MW (0–1 Mw)
- Analog input (0–100%)
- Firing (0–100%)
- Calibration

User Interface:
- Standard board-mounted LED interface
- Optional remote mount LCD display
  - Set/examine operating parameters
  - View status information
  - View line current, voltage and frequency in real time
  - Start and stop the solid state starter

1 Communication Port
Included:
- Modbus RTU / RS485

Optional with MXDE3:
- DeviceNet
- EtherNet
- EtherNet/IP
- Modbus TCP

Advanced Functionality:
- Dual ramp selection
- Adjustable kick current
- Programmable decel modes
- LV BIST test (built-in self test)
- Event log (99 events)
## Control Feature Comparison

<table>
<thead>
<tr>
<th>Function: SOFT STARTING AND STOPPING</th>
<th>MX²</th>
<th>MX³</th>
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</thead>
<tbody>
<tr>
<td>Voltage Ramp</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Current Ramp</td>
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<td>✓</td>
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<tr>
<td>TruTorque™ Ramp</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Power Ramp</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Tach/Speed Control Ramp</td>
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<td>✓</td>
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<tr>
<td>Linear Ramp Profiles</td>
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<td>✓</td>
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<tr>
<td>Squared and S Ramp Profiles</td>
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<tr>
<td>Dual Ramps</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Kicking</td>
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<tr>
<td>Voltage Decel</td>
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<td>✓</td>
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<tr>
<td>TruTorque™ Decel</td>
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<tr>
<td>DC Braking</td>
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<tr>
<td>Heater/Antiwindmill</td>
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<tr>
<td>Jogging 7-14% Speed</td>
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<tr>
<td>Slow Speed Cyclo™ Operation</td>
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<tr>
<td>0-40% speed</td>
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<tr>
<td>Inside Delta</td>
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<tr>
<td>Wye-Delta/Electromechanical Control</td>
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<tr>
<td>Phase Controller</td>
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<tr>
<td>Current Follower</td>
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<tr>
<td>ATL</td>
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<table>
<thead>
<tr>
<th>Function: PROTECTION</th>
<th>MX²</th>
<th>MX³</th>
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<tbody>
<tr>
<td>Separate Starting/Running</td>
<td>✓</td>
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<tr>
<td>Overload Classes</td>
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<tr>
<td>Adj. Hot/Cold Ratio</td>
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<td>Adj. Cooling Time</td>
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<tr>
<td>Intelligent Start Lockout</td>
<td>✓</td>
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<tr>
<td>Adj. OL Lockout Level</td>
<td>✓</td>
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<tr>
<td>Over/Under Current Protection</td>
<td>✓</td>
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<tr>
<td>Retained OL When Power Lost</td>
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<tr>
<td>Current Imbalance Protection</td>
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<tr>
<td>IOC (Instantaneous Over Current)</td>
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<tr>
<td>Open/Shorted SCR Detection</td>
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<td>Overcurrent/Shear Pin</td>
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<tr>
<td>Undercurrent/Load Loss</td>
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<tr>
<td>Residual Ground Fault Protection</td>
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<tr>
<td>Zero Sequence Ground Fault Protection</td>
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<tr>
<td>Starts Per Hour</td>
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<td>RTD Monitoring</td>
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<td>Motor PTC</td>
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<td>Stack OT Switch</td>
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<td>Stack Thermistor Input</td>
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<td>Backspin Timer</td>
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<td>Time Between Starts</td>
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<tr>
<td>Phase Rotation</td>
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<tr>
<td>Overvoltage</td>
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<tr>
<td>Undervoltage</td>
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<tr>
<td>Phase Loss</td>
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<tr>
<td>UTS/Stall Timer</td>
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<td>Zero Speed Switch</td>
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<td>PF Trip</td>
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<td>PORT (Power Outage Ride Through)</td>
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<tr>
<td>Keypad Fault Reset</td>
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<tr>
<td>Adj. Auto Fault Reset Timer</td>
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<tr>
<td>Adj. No. of Auto Resets Before Lockout</td>
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<tr>
<td>Decel After Fault</td>
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<tr>
<td>Fault Log</td>
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<tr>
<td>Time and Date Stamp</td>
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<tr>
<td>9 Data Snapshots of Each Fault</td>
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<td>Event Log (last 99 events)</td>
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<tr>
<td>Fault Classes</td>
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</table>
## Control Feature Comparison

<table>
<thead>
<tr>
<th>Function:</th>
<th>MX²</th>
<th>MX³</th>
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<tbody>
<tr>
<td><strong>USER I/O</strong></td>
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<tr>
<td>Programmable Digital Inputs</td>
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<td>Programmable Digital Outputs</td>
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<td>User Analog Input</td>
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<tr>
<td>Programmable User Analog Output</td>
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<tr>
<td>Local/Remote Source Input</td>
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<td>Power Up Start</td>
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<tr>
<td><strong>METERING</strong></td>
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<tr>
<td>Full Voltage and Current Metering</td>
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<tr>
<td>True RMS Calculation</td>
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<tr>
<td>Factory Menu Calibration</td>
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<tr>
<td>Current Imbalance Meter</td>
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<tr>
<td>Ground Fault Meter</td>
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<td>Watt Meters</td>
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<td>KVA Meters</td>
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<td>VAR Meter</td>
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<td>Watt Hour Meters</td>
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<td>Line Frequency Meter</td>
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<td>Power Factor Meter</td>
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<td>% OL Meter</td>
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<tr>
<td>Time Until OL Lockout Release Meter</td>
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<tr>
<td>Phase Rotation Meter</td>
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<tr>
<td>&amp; Power and % TruTorque™ Meter</td>
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<tr>
<td>Run Time Meter</td>
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<tr>
<td>Number of Starts Meter</td>
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<tr>
<td>Peak Current of Last Start Meter</td>
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<tr>
<td>Last Starting Time Meter</td>
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<tr>
<td>Analog Input Meter</td>
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<td>Real Time Clock</td>
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<td>RTD Meters</td>
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<tr>
<td><strong>MISCELLANEOUS</strong></td>
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<tr>
<td>LV BIST</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>MV BIST</td>
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<td>✓</td>
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<tr>
<td>LV Powered BIST</td>
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<td>✓</td>
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</tbody>
</table>
Open Chassis Starters
Non-Bypassed / Continuous Duty

RC SERIES MX² OR MX³ TECHNOLOGY
RUGGED INDUSTRIAL SOLID STATE STARTERS • 1 – 1200 HP / 208 – 600 Vac

RC Series Product Highlights:
The RC Series Solid State Starter combines the high performance MX² or MX³ control with the rugged, continuous duty, fan cooled RC stack.

The MX² or MX³ series control provides users with a powerful group of programming parameters, designed for flexibility in industrial applications. The MX² and MX³ both provide simple setup and commissioning via the Quick Start Menu.

The RC power section is a rugged non-bypassed section. It is an economical solution at low horse-power. In addition, the fan cooled stack provides high duty cycle and high inertia starting and energy saver operation.

Key Advantages:

- Economical at low horsepower
- High duty cycle starting
- Long starting times
- Suitable for jogging applications
- Fan cooled stack
- Energy saver applications
- Integrated motor protection
- Modbus standard / Profibus, Ethernet, DeviceNet, Ethernet IP web addressable communication protocols are available via optional communication bridges
- 1.25 service factor
- Integrated metering and diagnostics
- Multiple starting ramps for various applications
RB Series Product Highlights:

Benshaw’s RB series solid state starter combines the high performance MX² or MX³ technology with a rugged, compact, integral bypass RB series power section.

The MX² or MX³ technology provides users with a powerful group of programming parameters, designed for flexibility in across a wide range of industrial applications. Both MX² and MX³ controls provide simple setup and commissioning via the Quick Start Menu.

The RB power section is a rugged, heavy duty solid state starter section designed with integral bypass contactors for a compact, efficient profile. The modular design includes separate poles for each phase for ease of maintenance.

Key Advantages:
- Small, compact design
- Modular power stack assembly for ease of maintenance
- Modbus standard / other Fieldbus optional
- Multiple starting ramps for various applications
- Integrated metering system diagnostics
- Integral bypass contactors for efficient operation, eliminating the need for external fans
- Integrated motor protection
- Dual ramp capability for loaded / unloaded applications
- Power stack has multiple ratings for application flexibility
Prepackaged Starters with ATL Bypass
Severe Duty 480V

MX² / MX³ RX2E SERIES OR RX3E
NEMA 12 / COMBINATION / REDUNDANT

RX2E Series Product Highlights:

RX2E starters provide solid state reduced voltage starting for normal operation and full voltage emergency backup starting with complete electronic motor protection at the flip of a switch. This unique redundant design is the ideal solution for critical applications where downtime is extremely disruptive to production operations and cannot be tolerated. Benshaw’s MX solid state controls provide precise digital starting and stopping, motor protection, metering, diagnostics and communications.

Units are stocked with MX² technology, but are also available with MX³ technology.

Standard Features:

• NEMA 12, redundant, combination/circuit breaker
• Shunt trip on main circuit breaker
• 500%–30 seconds rated solid state starter, UL certified and listed
• 1800 PIV rated SCRs, UL certified and listed
• 125% continuous duty rated solid state starter, UL certified and listed
• Selector switch for selecting solid state or full voltage operation mounted inside enclosure
• Full HP rated bypass contactor with a 1.15 service factor, wired for normal bypass operation and full voltage start and run operation, with normally open auxiliary contact.
• Separately mounted “SPE” series overload relay wired for full voltage start and run operation.
• 110 volt control power transformer with primary and secondary fuses
• Door mounted start and stop push-buttons
• Door mounted keypad
• Door mounted run indicating light
• Door mounted local-off remote switch
• Door mounted overload reset
• Terminal strip mounted inside enclosure for remote start/stop connection
• Auxiliary relay with (2) Form C run contacts
• Benshaw MX² programmable motor controller with soft start, soft stop and motor protection capabilities
• RS485 Modbus communications
• Analog I/O
• Available with MX³ technology
• Optional NEMA 4 enclosure
Configure the MX2PB / MX2PC to fit your application

MX2PB / MX2PC configurable solid state starters stocked as:

- Non-combination
- Combination circuit breaker
- Rotary disconnect operator
- Non-bypass
- Bypass contactor
- NEMA 4 or 12 enclosure
- Modular operator station
- 480 V
- Standard 120 V control power transformer
- Service entrance rated with circuit breaker

1. Select a starter type:
   - MX2PC modular non-bypass or
   - MX2PB modular bypassed

2. Select a horsepower rating
3. Select a voltage
4. Select an enclosure
5. Select a circuit breaker (or none)
6. Select your options
RB2/RB3 Series Starter with DC Injection Brake

SOLID STATE STARTER WITH DC INJECTION CONTROL

RATINGS

<table>
<thead>
<tr>
<th>Power</th>
<th>Horsepower: 20 - 1,500 HP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overload</td>
<td>500% for 30 seconds</td>
</tr>
<tr>
<td></td>
<td>125% continuous</td>
</tr>
<tr>
<td>Starting</td>
<td>0 - 100%</td>
</tr>
<tr>
<td>Voltage</td>
<td>200 - 1,000 Vac</td>
</tr>
<tr>
<td>Duty</td>
<td>300% braking current for 30 seconds</td>
</tr>
<tr>
<td>Duty</td>
<td>300% braking current for 60 seconds</td>
</tr>
</tbody>
</table>

DC Injection Braking Starter Product Highlights:

Benshaw offers a microprocessor controlled solid state reduced voltage starter with dc injection braking for three phase induction motors. The starter provides a closed loop current ramp for smooth stepless motor acceleration.

The MX² / MX³ starter with dc injection brake consists of the Benshaw 3 phase SCR power stack for the soft start, with an integrated SCR power block power fuse and control logic for the dc injection circuit.

The MX² / MX³ dc injection brake SCR system allows a free wheeling path for the dc current that circulates in the motor windings. When the dc current is applied to the ac motor windings, braking action is achieved as the circulating motor rotor tries to align itself with the stationary dc field, thus giving the motor smooth electronic braking action.

Key Advantages:

- Benshaw MX² / MX³ technology
- Standard and heavy duty dc injection brake configurations available
- Modular power stack design for ease of maintenance
- Solid state starter and dc brake integrated in one package
- Integral bypass contactor design
- Advanced MX² / MX³ motor protection
- Advanced MX² / MX³ metering function
- Real time clock
- 99 event log history
- Modbus communication
- Configurable output relays
- Reduced maintenance
- Reversing capabilities are also available
Synchronous Starter

MX² SEP SERIES - SOLID STATE STARTER WITH SYNCHRONOUS CONTROL

RATINGS

<table>
<thead>
<tr>
<th>Horsepower:</th>
<th>20 - 1,500 HP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overload:</td>
<td>500% for 30 seconds</td>
</tr>
<tr>
<td></td>
<td>125% continuous</td>
</tr>
<tr>
<td>Starting Torque:</td>
<td>0 - 100%</td>
</tr>
<tr>
<td>Voltage:</td>
<td>200 - 1000 Vac</td>
</tr>
</tbody>
</table>

Includes discharge resistor and synchronous excitation package for brush type and brushless motor.

Exciter Ratings: 125 - 250 Vdc
                    30 - 300 A

Synchronous Starter Product Highlights:

The sync motor functions as an induction motor during start up. Once the motor approaches full synchronous speed, the MX² / MX³ dc exciter induces a constant polarity to the rotor causing the motor to lock into sync. Because the rotor's field is constant and separately excited there is no slip required to produce torque, as with an induction motor. This allows the motor to run at synchronous speed.

The Benshaw synchronous package consists of a solid state starter portion connected to the stator and an SEP (synchronous excitation package) that is connected to the rotor section in conjunction with a discharge resistor. This SEP is supplied for brush type and brushless exciters.

Synchronous Benefits

The MX² / MX³ series solid state starter provides reduced voltage stepless acceleration and automatic synchronization of three phase ac synchronous motors. Synchronous motors are utilized for a number of reasons. They are used in applications that require precise motor speed. They are used to obtain greater efficiencies, and they are used for facility power factor correction.

Since synchronous motors can be operated at leading power factor, they are used to correct a facility's lagging power factor created by all the other induction motors being operated.

This correction reduces the penalty a customer pays the utility company for creating poor power factor.

Synchronous motors are not sensitive to electrical harmonic problems.

Key Advantages:

- Benshaw synchronous technology
- Solid state synchronous rotor control
- Modular power stack design for ease of maintenance
- Integral bypass contactor design
- Advanced synchronous motor protection
- Can be added to existing equipment
- Can be supplied with MX² or MX³ starter control
- Modbus communication
- Configurable output relays
- Reduced maintenance
- Reduction in size compared to existing field control
- Stepless control
- Reduces inrush while maintaining torque
- Brush type and brushless control
Wound Rotor Starter
WITH MX³ TECHNOLOGY - SOLID STATE STARTER WITH WOUND ROTOR CONTROL

Wound Rotor Starter Product Highlights:

Wound rotor motors are typically used in applications requiring high starting torques, a limited number of operating speeds, or a stepped acceleration to achieve a soft start. Typical existing applications utilize an electromechanical starter on the stator and introduce multiple stages of resistance in the rotor via contactor arrangements to achieve a soft ramp.

With the MX³ technology, wound rotor control is greatly simplified. The MX³ technology consists of two major sections: 1) A solid-state stator control, and 2) a single step of resistance into the rotor circuit from a separate 3-phase resistor bank. This achieves the high torque required by the application—with low inrush—while providing a smooth stepless start. This greatly reduces the maintenance cost of the typical electromechanical control.

RATINGS

| Horsepower: | 20 - 1500 HP |
| Overload:   | 500% for 30 seconds 125% continuous |
| Starting Torque: | 0 - 100% |
| Voltage:    | 200 - 1000 Vac |
| Typical Resistance Steps: | 1-2 |

Key Advantages:

- Benshaw MX³ technology
- Single step rotor control
- Modular power stack design for ease of maintenance
- Integral bypass contactor design
- Advanced MX³ motor protection
- Advanced MX³ metering function
- Real time clock
- 99 event log history
- Modbus capable
- Configurable output relays
- Multistep & variable speed rotor control available
- Reduced maintenance
- Reduced in size and number of resistors needed
- Stepless control
- Reduces inrush while maintaining torque

Single Step Rotor Control

The solid-state starter is wired to the motor stator circuit, and the resistor and shorting contactor are wired to the motor rotor circuit. The solid state starter accelerates the motor to slip speed (determined by the resistance value) and then activates the contactor to short the rotor. This allows the motor to accelerate to full speed.

Multiple Step Rotor Circuit

RBW series starters can be supplied with multiple stages of rotor resistor and contactor combinations. This arrangement may be necessary for multiple step starting of extremely high inertia loads, or for continuous operation at multiple speeds. Multiple steps of rotor resistance can be coordinated to achieve this.

Variable Speed Control

Variable speed control of wound rotor motors can be accomplished with the MX³ technology series control. By maintaining full output voltage of the control going to the stator of the wound rotor motor, and varying the resistance in the rotor, variable speed is accomplished.

Resistors must be rated for continuous duty operations. Variable loads (pumps and fans) only.
Benshaw has developed advanced engineering, drafting, materials management and quality systems focused on designing and building customer solutions. This “Build to Order” capability combined with an extensive inventory of control components, protective relays, circuit breakers, contactors, enclosures and other electrical / electronic devices enables Benshaw to quickly ship engineered products.

**Control Modifications — *Whatever You Specify***

- Over 250 modifications and accessories are available, including: pilot devices, PLC’s, control power transformers, switches, meters, relays, space heaters, and protective devices.

**Combination Starters — *to Meet Your Requirements***

- 15 to 2,000 A circuit breakers
- 40 to 2,000 A non-fused disconnects
- 30 to 800 A fuse disconnect
- Flange or rotary handle mechanism

**Power Stacks — *to Fit Your Application***

- Continuous duty / non-bypassed
- Integral bypass
- Standard, heavy, and severe duty
- Emergency across-the-line bypass

**Enclosures — *to Match Your Environment***

- Standard designs — NEMA 1, 12, 4 chassis
- Custom enclosures
- Special enclosures — 3R, 4X, 7, 9, as specified
- Motor control centers

**Communication**

- Modbus / RS485
24/7 Technical Support

Benshaw is dedicated to providing comprehensive 24-hour-a-day, 7-day-a-week phone support. Benshaw provides repair, spare parts, field engineering, retrofit, and training services, when and where you need us. You can count on our experienced team, backed by the latest diagnostics and repair tools and an extensive parts inventory to support your operations.

Call 1.800.203.2416

24/7 Hotline Support from our operations in Pittsburgh and Listowel (Canada):

- Technical phone support
- Overnight parts shipment
- 24-hour service dispatch
- Coordination of all service capabilities

Repairs

Repairs are made on Benshaw equipment by trained, experienced personnel, using the latest diagnostic and test equipment.

Field Services are performed on-site by skilled technicians, engineers, or complete teams if needed, including:

- Start-up commissioning
- Field repairs
- Field analysis/data collection
- Preventative maintenance

The Benshaw Product Line

A wide range of motor controls and drives are available:

- Solid state starters fractional up to 30,000 HP at 15 kV
- AC drives to 700 HP
- Electromechanical controls to 800 A

Benshaw Express is a 24/7 online inventory and order entry system for authorized Benshaw distributors:

- 24/7 shipment
- Either air or truck delivery

Specifications are subject to change without notice.
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