Intelligent Low Voltage Solid State Motor Control Products

with next generation MX²/MX³ technology

MX^2 Control Technology

Next Generation Intelligent Motor Control

Next Generation Intelligent Motor Control

- 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
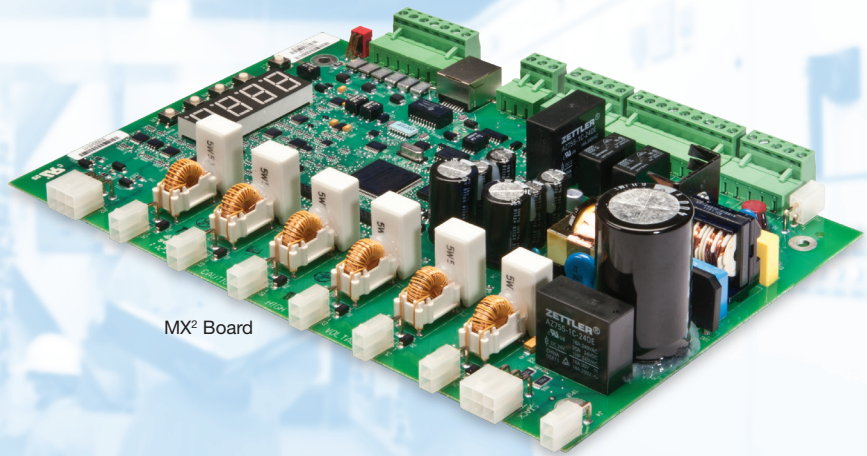
MX^2 Board

Optional Keypad

MX^2 Control Highlights

The MX^2 control technology from Benshaw provides a powerful, flexible, intelligent low voltage motor control platform. MX^2-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 MX^2 technology an excellent choice for a wide range of intelligent, soft start motor control applications.

Benshaw's MX^2-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 MX^2-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
- Overcurrent trip
- Undercurrent 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 Input Configurable to:

- Trip high level
- Trip low level

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:
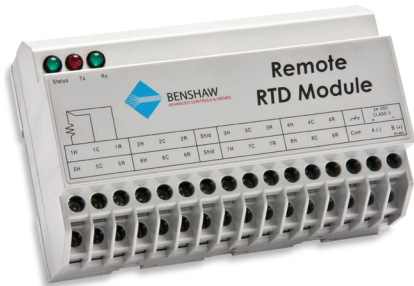
- DeviceNet
- Ethernet
- Ethernet/IP
- Modbus TCP

Advanced Functionality:

- Dual ramp selection
- Adjustable kick current
- Programmable decel modes
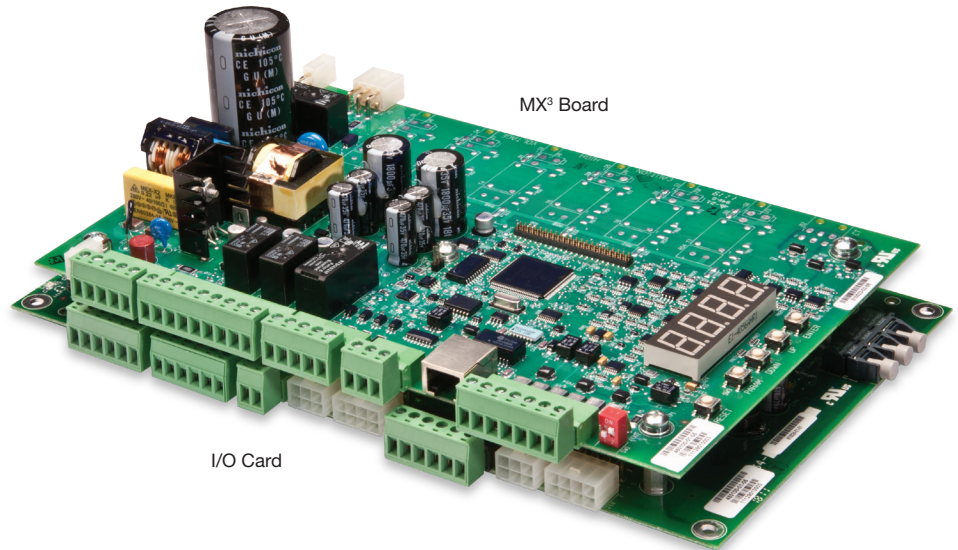- LV BIST test (built-in self test)

MX³ Control Technology

Next Generation Intelligent Motor Control

Optional RTD modules

Keypad (Included)

MX³ Board

I/O Card

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)

MX³ 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
- Cyclo™ converter control

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
- Shorted SCR
- Disconnect fault
- Ground fault (residual or zero sequence)
- 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
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- Heater enable
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- Dual ramp selection
- 1 dedicated start input
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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

Function:	MX^2	MX^3
Soft Starting and Stopping		
Voltage Ramp	✓	✓
Current Ramp	✓	✓
TruTorque™ Ramp	✓	✓
Power Ramp	✓	✓
Tach/Speed Control Ramp		✓
Linear Ramp Profiles	✓	✓
Squared and S Ramp Profiles		✓
Dual Ramps	✓	✓
Kicking	✓	✓
Voltage Decel	✓	✓
TruTorque™ Decel	✓	✓
DC Braking	✓	✓
Heater/Antiwindmill	✓	✓
Jogging 7–14% Speed	✓	✓
Slow Speed Cyclo™ Operation 0–40% speed	✓	✓
Inside Delta	✓	✓
Wye-Delta/Electromechanical Control	✓	✓
Phase Controller	✓	✓
Current Follower	✓	✓
ATL	✓	✓

Function:	MX^2	MX^3
Protection		
Separate Starting/Running Overload Classes	✓	✓
Adj. Hot/Cold Ratio	✓	✓
Adj. Cooling Time	✓	✓
Intelligent Start Lockout		✓
Adj. OL Lockout Level		✓
Over/Undercurrent Protection	✓	✓
Retained OL When Power Lost	✓	✓
Current Imbalance Protection	✓	✓
IOC (Instantaneous Overcurrent)	✓	✓
Open/Shorted SCR Detection	✓	✓
Overcurrent/Shear Pin	✓	✓
Undercurrent/Load Loss	✓	✓
Residual Ground Fault Protection	✓	✓
Zero Sequence Ground Fault Protection		✓
Starts Per Hour		✓
RTD Monitoring		✓
Motor PTC		✓
Stack OT Switch	✓	✓
Stack Thermistor Input	✓	✓
Backspin Timer		✓
Time Between Starts		✓
Phase Rotation	✓	✓
Overvoltage	✓	✓
Undervoltage	✓	✓
Phase Loss	✓	✓
UTS/Stall Timer	✓	✓
Zero Speed Switch		✓
PF Trip		✓
PORT (Power Outage Ride Through)		✓
Keypad Fault Reset	✓	✓
Adj. Auto Fault Reset Timer	✓	✓
Adj. No. of Auto Resets Before Lockout	✓	✓
Decel After Fault	✓	✓
Fault Log	✓	✓
Time and Date Stamp		✓
9 Data Snapshots of Each Fault	✓	✓
Event Log (last 99 events)		✓
Fault Classes		

Function:	MX²	MX³
Metering		
Full Voltage and Current Metering	✓	✓
True RMS Calculation	✓	✓
Factory Menu Calibration	✓	✓
Current Imbalance Meter	✓	✓
Ground Fault Meter	✓	✓
Watt Meters	✓	✓
KVA Meters	✓	✓
VAR Meter	✓	✓
Watt Hour Meters	✓	✓
Line Frequency Meter	✓	✓
Power Factor Meter	✓	✓
% OL Meter	✓	✓
Time Until OL Lockout Release Meter	✓	✓
Phase Rotation Meter	✓	✓
& Power and % TruTorque™ Meter	✓	✓
Run Time Meter	✓	✓
Number of Starts Meter	✓	✓
Peak Current of Last Start Meter	✓	✓
Last Starting Time Meter	✓	✓
Analog Input Meter	✓	✓
Real-Time Clock		✓
RTD Meters		✓

Function:	MX²	MX³
User I/O		
Programmable Digital Inputs	✓	✓
Programmable Digital Outputs	✓	✓
User Analog Input	✓	✓
Programmable User Analog Output	✓	✓
Local/Remote Source Input	✓	✓
Power Up Start	✓	✓

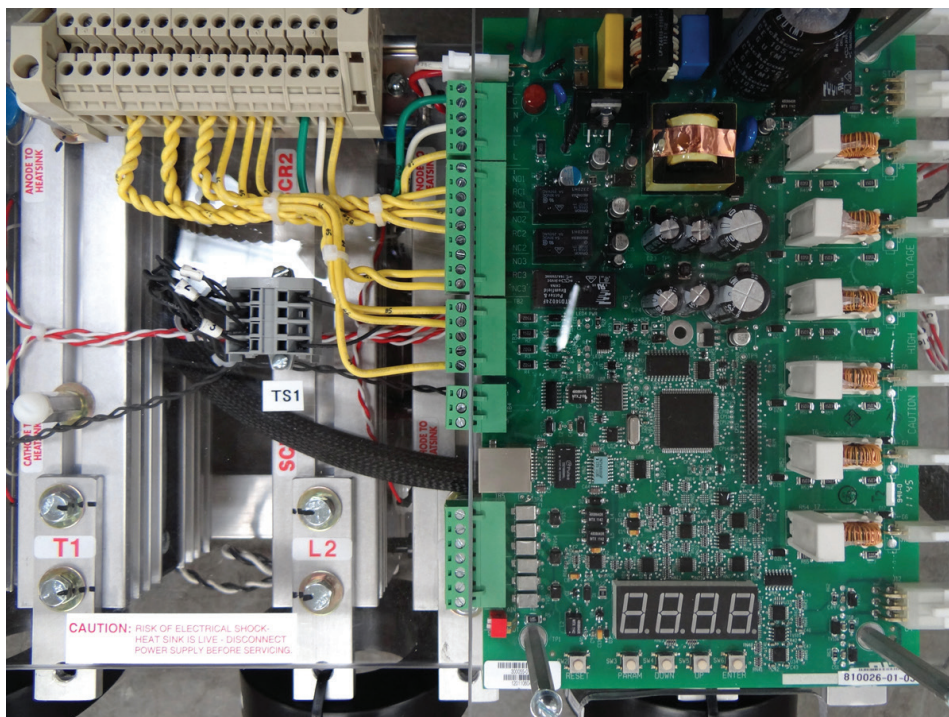| Function:	MX²	MX³
Miscellaneous		
LV BIST	✓	✓
MV BIST	✓	✓
LV Powered BIST	✓	✓

Open Chassis Starters
Non-Bypassed/Continuous Duty

RC Series MX^2 or MX^3 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 MX^2 or MX^3 control with the rugged, continuous duty, fan cooled RC stack.

The MX^2 or MX^3 series control provides users with a powerful group of programming parameters, designed for flexibility in industrial applications. The MX^2 and MX^3 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

Open Chassis Starters with Integral Bypass

RB Series with MX^2 Technology (also available with MX^3 Technology)

RB Series Product Highlights

Benshaw's RB series solid state starter combines the high performance MX^2 or MX^3 technology with a rugged, compact, integral bypass RB series power section.

The MX^2 or MX^3 technology provides users with a powerful group of programming parameters, designed for flexibility in across a wide range of industrial applications. Both MX^2 and MX^3 controls provide simple setup and commissioning via the Quick Start Menu.
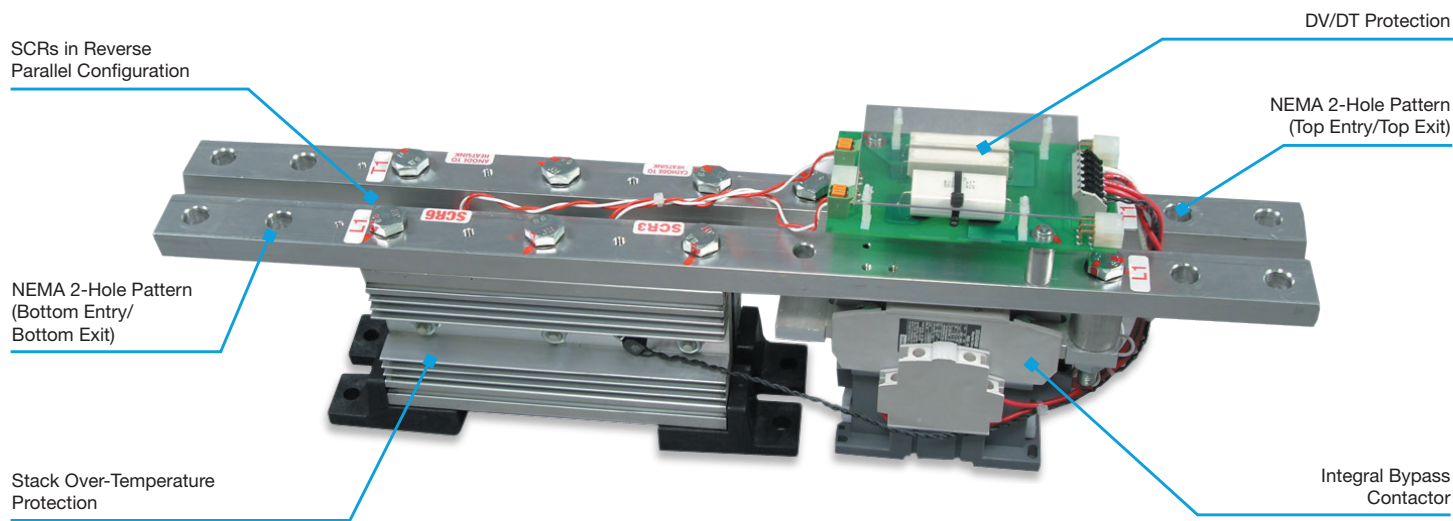
The RB power section is a rugged, heavy duty solid state starter section designed with integral bypass contactors for a compact, efficient profile. The modular design includes separate poles for each phase for ease of maintenance.

Rugged Industrial Solid State Starters with Integral Bypass

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

RB Power Pole—180 A

SCRs in Reverse Parallel Configuration

NEMA 2-Hole Pattern (Bottom Entry/ Bottom Exit)

Stack Over-Temperature Protection

DV/DT Protection

NEMA 2-Hole Pattern (Top Entry/Top Exit)

Integral Bypass Contactor

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 pushbuttons
- 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

A member of UNICO Technologies Group

Prepackaged Starters Non-Bypassed / Continuous Duty and Integral Bypass

MX²PB / MX²PC Series

**Prepackaged Starters with MX2 Technology.
Modified for Next Day Shipment.**

Configure the MX²PB/MX²PC to fit your application

Standard Features

- 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 bypass

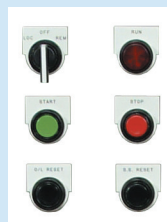2. Select a horsepower rating

3. Select a voltage

4. Select an enclosure

5. Select a circuit breaker (or none)

6. Select your options
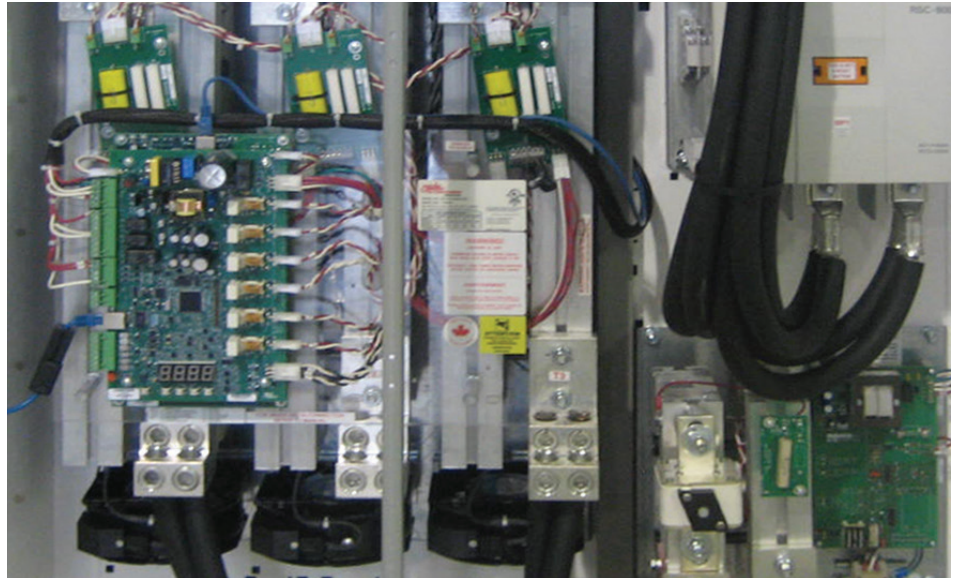
(Stock Unit Shown)

RB2/RB3 Series Starter with DC Injection Brake

Solid State Starter with DC Injection Control

Ratings:

Horsepower: 20–1,500 HP

Overload: 500% for 30 seconds
125% continuous

Starting Torque: 0–100%

Voltage: 200–1,000 Vac

Standard Duty: 300% braking current
for 30 seconds

Heavy Duty: 300% braking current
for 60 seconds

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 MX^2 / MX^3 starter with dc injection brake consists of the Benshaw three-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 MX^2 / MX^3 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 MX^2 / MX^3 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 MX^2 / MX^3 motor protection
- Advanced MX^2 / MX^3 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

Horsepower:	20–1,500 HP
Overload:	500% for 30 seconds
	125% continuous
Starting Torque:	0–100%
Voltage:	200–1,000 Vac

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 MX^2 / MX^3 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 MX^2 / MX^3 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 MX^2 or MX^3 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
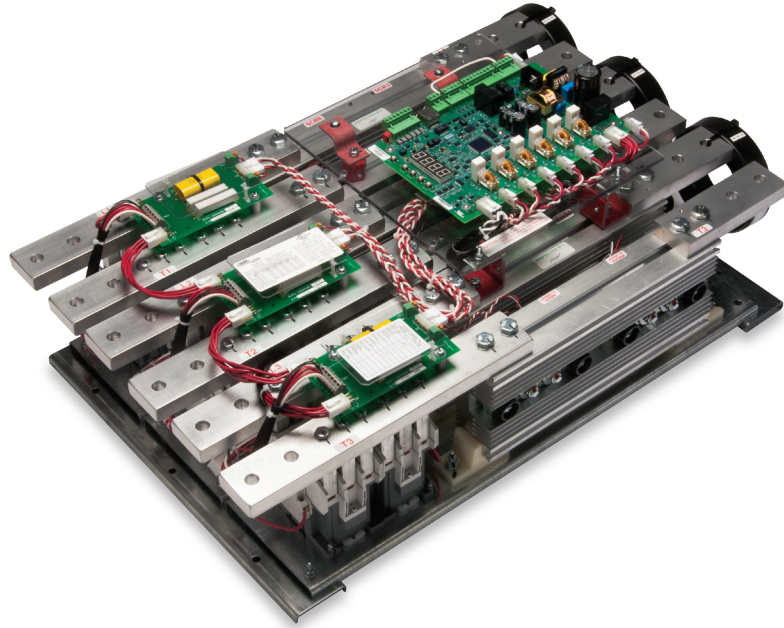
Wound Rotor Starter Product Highlights

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 three-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.

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.

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 and variable speed rotor control available
- Reduced maintenance
- Reduced in size and number of resistors needed
- Stepless control
- Reduces inrush while maintaining torque

Engineered Packages

Product Overview

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,PLCs, 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 fusible disconnects
- 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 — NEMA 3R, 4X, 7, 9, as specified
- Motor control centers

Communication

- Modbus / RS485

Advanced Controls and Drives

- Full Voltage Controls
- Variable Frequency Drives
- Low Voltage Solid State Starters
- Medium Voltage Drives
- Medium Voltage Controls
- Medium Voltage Switchgear

UNICO Technologies Group
Power and Precision in Motion

Taking care of our customers' power needs has been our single focus for 88 years. Our two leading brands bring innovative control and electrical solutions to solve your challenges. Through thousands of systems in a broad array of applications, we've learned what it takes to make your system live up to its potential.

At a glance: With facilities in 12 countries, we combine the convenience of local service with the economies-of-scale and efficiency of a large global organization.

Innovative solutions via technology: We bring you mission-critical motor control and protection products, designed and built with expertise and precision to maximize your output and minimize downtime.

Engaged and knowledgeable: We like to think of ourselves as "Application Smart," which always includes critical dependencies such as standards, compliance and regulatory issues.

UNIC O
TECHNOLOGIES GROUP
Power and Precision in Motion

Visit us online at unicotg.com, or contact:

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