BENSHAW
Applied Motor Controls

SPECIFICATION GUIDE

RediStart™ MVRMX

Medium Voltage Solid State Soft Starter with MX^3 Control

Rapid | Rugged | Global

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1 INTRODUCTION

1.1 INTRODUCTION

Benshaw has prepared this Specification Guide for engineers, plant maintenance personnel, and electrical consultants who need to specify and describe solid state reduced voltage motor starters.

The Benshaw RediStart MVRMX reduced voltage starter is a microprocessor controlled solid state starter for single-phase or three-phase AC induction motors. The starter can be custom designed for specific applications, and provides multiple ramps for smooth seamless motor acceleration and deceleration.

1.2 SCOPE

General Information

The RediStart MVRMX specification guide outlines the fabrication, performance, and functional specifications for microprocessor based, solid-state motor controls designed and manufactured by Benshaw, Inc. for application on NEMA design A through F induction motors as well as wound rotor. For two speed or synchronous motors consult Benshaw. The RediStart MVRMX solid state starter shall meet the requirements as specified herein.

- Provide all labor, materials, equipment and incidentals required, and install, place in operation and field test solid state starter(s).
- The solid state starter(s) must fit in the space indicated on the drawings.

How to Use this Specification

The Specification guide is divided into four sections:

- Introduction
- Electrical Specifications
- Mechanical Specifications
- Benshaw Quality

Each section contains subsections with detailed information on the relative topics. The subsections contain general information, details and any necessary precautions about the individual topics. The specific information contained in the subsections can be found quickly and easily by reviewing the subject headings on the left margin.

Specification Guide On-Line

The specification guide can be found on-line at:
http://www.benshaw.com

This manual is available in Adobe Acrobat portable document format (pdf). Adobe and Acrobat are trademarks of Adobe Systems Incorporated.

1.3 QUALIFICATIONS

Manufacturer

The solid-state starters shall be the product of a manufacturer who has produced solid state starters of the same type and size for a minimum of 20 years consecutive. When requested by the Engineer, a Users List, complete with telephone numbers and contact persons shall be furnished for verification.

- Acceptable Manufacturers:
  Benshaw
  Substitutions: None permitted

Support

The manufacturer shall maintain factory trained and authorized service facilities and shall have a demonstrated record of service for a least the previous ten years.

- Support personnel are to be direct employees of the manufacturer.
- The manufacturer shall provide all required start-up training services. The approved manufacturers are:
  Benshaw
  Substitutions: None

Certification

Third party manufacturers and brand labeling shall not be permitted.

Codes & Standards

The RediStart MVRMX starters are designed, manufactured, and tested at Benshaw to conform, where applicable, to the following industry standards and specifications:

ANSI American National Standards Institute
CSA Canadian Standards Association
IEEE Institute of Electrical & Electronic Engineers
UL Underwriters Laboratories
CE Conformité Européene (European Conformity)
NEC National Electric Code
EEMAC Electrical & Electronic Manufacturers Association of Canada
NEMA National Electronic Manufacturers Association
OSHA Occupational Safety & Health Act

Unit(s) must be approved and/or certified by, and carry the label(s) of the Underwriters Laboratories (UL). Units shall be UL / cUL 347 listed as a complete assembly, including all necessary sub assemblies and components in the same package.

EMC

The products must meet these EMC standards:

- EN 61000-6-4 :2001 Emissions Radiated/Conducted
- EN 55011/05.98+A1:1999
- EN 61000-6-2 :2001 Immunity/Susceptibility which includes:
- EN 61000-4-2 Electrostatic Discharge
- EN 61000-4-3 Radiated RF
- EN 61000-4-4 Electrical Fast Transient/Burst
- EN 61000-4-5 Surge
- EN 61000-4-6 Injected Currents
- EN 61000-4-8 Magnetic
- EN 61000-4-11 Voltage Dips

1.4 PRE-MANUFACTURE SUBMITTALS

A. Submittals shall be furnished in accordance with Spec. Section_____.

B. Shop Drawings:
- Elementary wiring and interconnection diagrams in accordance with NEMA ICS standards.
- Enclosure frontal elevation and dimension drawings.
- Internal component layout diagrams.
- Available conduit entry and exit locations.
- Unit descriptions including amperage ratings, frame sizes, trip settings, pilot devices, etc.
- Nameplate information

C. Product Data:
- Manufacturer's product data sheets on all major components
- Certification of conformance to "Buy American" steel acts
- Publications on solid state reduced voltage starters

D. Specification Response:
- Detailed response to this specification showing where in the literature each requirement is satisfied.
- All clarifications and exceptions must be clearly identified.

E. Testing and Test Reports:
- Testing shall be per manufacturers standard
- A copy of the test reports shall be provided as part of the closeout documentation

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section _____ for procedure on submittal of closeout documentation.
B. Contractor shall provide certification that the solid state reduced voltage controller has been installed in accordance with the manufacturers instructions.
C. The Contractor shall provide certification that the Contractor has properly adjusted any timing devices required in the starting circuitry.
D. Final Drawings:
   - The manufacturer shall provide final drawings reflecting the "As Shipped" status of the installed equipment.
   - The Contractor shall be responsible for making any changes to the "As-shipped" drawings from the manufacturer to reflect any field modifications.
E. Maintenance Data:
   - The manufacturer shall provide instructions for storage, handling, protection, examination, preparation, installation, and starting of the RediStart MVRMX solid state starter.
   - Provide user's manual, along with installation/operation instructions for major components, and parameter list.
   - Include spare parts listing with name and phone number for a local distributor for the spare parts.

1.6 DELIVERY, STORAGE AND HANDLING

A. Handling and shipment of the equipment shall be in such a manner to prevent internal component damage, breakage, and denting and scoring of the enclosure finish.
B. Equipment shall be stored indoors in a clean, dry environment. Energize space heaters if furnished.
C. The contractor shall protect the units from dirt, water, construction debris and traffic.

1.7 EXECUTION

Testing

- All incoming material shall be inspected and/or tested for conformance to quality assurance specifications.
- Power semiconductors shall be fully tested for proper electrical characteristics, including dv/dt and di/dt.
- All subassemblies shall be inspected and/or tested for conformance to quality assurance specifications.
- Each completed unit shall be functionally tested prior to shipment to assure conformance to the specifications.

Startup & Training

- Bid price shall include two visits, consisting of two consecutive days each, for startup and training. Services shall include startup of equipment and field/classroom training for owner's personnel. Factory direct personnel shall provide startup and training only. The use of agents, manufacturer's representatives, associated integrators or manufacturer's distributors for startup and training shall not be permitted.

Field Measurements

A. The contractor shall verify all field measurements prior to the fabrications of the solid state reduced voltage starter.

1.8 SPARE PARTS (OPTIONAL)

A. Spare parts shall include, but not be limited to:
   - One (1) set of Printed Circuit Boards
   - One (1) of each type and size of Control Fuse
   - Three (3) of each type and size of Power Fuse
   - One (1) complete spare Power Cell of each type and size used
   - One (1) complete spare RTD Monitoring Device

1.9 WARRANTY

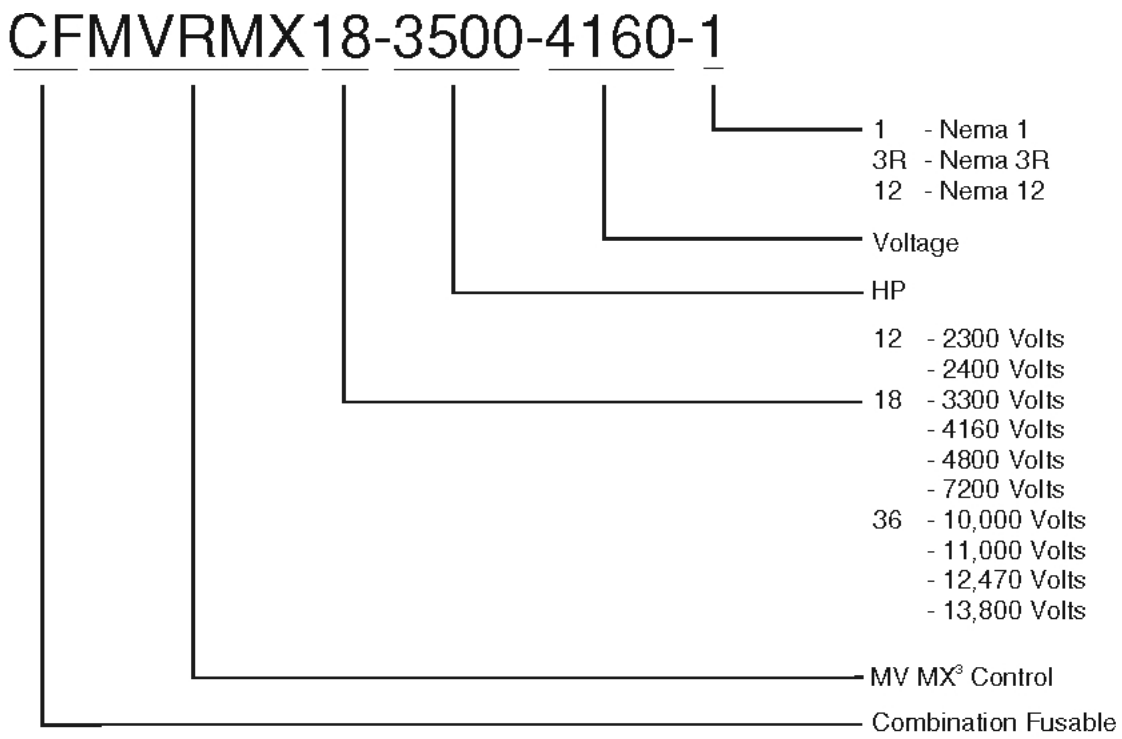
A. The manufacturer shall provide their standard three (3) year manufacturers warranty (from date put into service) on all solid state power sections and P.C. solid state control cards.
B. The manufacturer shall provide a one (1) year manufacturers warranty (from date put into service) on all other equipment of each system.
C. The manufacturer shall confirm this warranty as part of the submittal.
D. Specification

2 ELECTRICAL SPECIFICATIONS

2.1 MODEL NUMBER FORMAT

Specifying Model Numbers

The starter numbering system for MVRMX is:



Example of Model Number: CFMVRMX18-3500-4160-1
A Combination Fusable RediStart starter with MV MX³ control, 4160 Volts, 3500 Horse Power, NEMA 1 Enclosure.

2.2 DESIGN SPECIFICATIONS

General Information

The starter can be custom designed for specific applications.

The starter offers:

- Solid state design
- Starting Profiles
- Stopping Profiles
- Programmable Analog Output
- Programmable Digital Inputs
- Programmable Relay outputs
- Programmable motor protection
- Programmable operating parameters
- Programmable metering options
- Communications
- Advanced features

Available in NEMA (National Electrical Manufacturers Association) specified frame sizes, the starter may be used in numerous industrial applications. Each starter can operate within applied voltage and frequency values of 2100VAC to 13800VAC and 23 to 72Hz. This feature enables it to be installed in a wide range of sites and countries.

The starter can be programmed for any motor FLA and all of the common motor service factors. It enables operators to control both motor acceleration and deceleration. It also protects the motor and its load from damage that could be caused by incorrect phase order wiring.

The starter continually monitors the amount of current and power being delivered to the motor. This protects the motor from overheating or drawing excess current or power. The starter will automatically stop the motor if the phase-to-phase current is not within acceptable ranges or if the current is lost in a line.

Power Requirements

The MVRMX starters are designed to operate with three-phase AC power at the following nominal voltages:

- Line Voltage: 2100 to 13800VAC 3 phase
- Control Voltage: 120VAC single phase

All starters are designed for universal operation at 23Hz through 72Hz at ambient temperatures of up to 40 C. Control voltage is specified by the customer at time of order and may not be modified by the customer.

Power Section

Depending on the application, certain power section requirements must be met.

For standard duty applications, the power stack must be able to withstand 350% of the starter nominal current rating for 30 seconds. For heavy duty applications, the power stack must be able to withstand 500% of the starter nominal current rating for 30 seconds. For severe duty applications, the power stack must be able to withstand 600% of the starter nominal current rating for 30 seconds.

In all cases the stack must be able to withstand the current draw without damage, tripping or faulting due to thermal overload. Also, the manufacturer must provide test data verifying these ratings.

Bypass Contactor

The RediStart MVRMX is provided with a bypass contactor. The bypass contactor will effectively "short" the SCR power section to connect the incoming line to the motor load without the SCR voltage drop. This will help protect the SCRs against voltage and current surges and reduce the amount of heat generated by the starter. The bypass is a HP rated contactor that can be used to bypass the soft-starter or to across-the-line start the motor if the soft-starter fails.

In-Line Contactor

The RediStart MVRMX is provided with an in-line contactor. The in-line contactor will provide voltage isolation to the starter while the starter is in a stopped state. The RediStart MVRMX will automatically sequence the energizing of the in-line contactor.

DESCRIPTION	SPECIFICATION
Starter type	Closed loop current control, TruTorque, Voltage Ramp, Power, Tach
Horsepower HP	(Please specify)
Power ratings	500% FLA for 30 sec., 115% continuous
PIV ratings	2.5 x line volts or minimum of 8000 PIV
Starting torque	0 to 100%
Ramp time	0 to 300 seconds
Maximum BIL rating	45/60KV - 7200V max. 90/110KV - 15KV max
Nominal ratings	2200, 2300, 2400, 3300, 4160, 4600, 4800, 6000, 6600, 6900, 10000, 11000, 11500, 12000, 12470, 13200, 13800 VAC
	23 to 72 Hz
Standard insulation test	2 times voltage plus 2000 VAC minimum
SCR voltage drop "L" to "T"	4.2 Volts (Max)
Overall efficiency	99.7%
SCR firing technique	Fiber Optic Continuous Hard Gate Drive
Transient protection	DV/DT Snubber Network
Diagnostics & LED's	Power On
	CPU Heart Beat
	Phase Condition
	LCD display (16 character by two lines) Communication RTD Module Fiber Optic firing
Over/under voltage protection	Adjustable 1% to 40% over/under voltage
Control input	120 VAC or Dry Contact, 2 or 3 wire

Audible Noise

Not to exceed 60dbA @ 1 meter at any time

Max. Time Between Restarts

Adjustable

General Logic Control Configuration

The RediStart MVRMX is supplied standard with programming buttons and local start/stop buttons on one main keypad with the LCD display. Provisions for optional two or three wire 120VAC remote control is provided at a terminal block on the starter.

The standard electronic control logic, which is located on a microprocessor-based PC card, provides the sequential logic as well as gating signals used to drive the SCRs. The control system is designed to implement the required sequential logic to start and stop the motor as well as operate the bypass contactor and an inline isolation contactor. The control logic is designed to perform the timing required for operation while continuously monitoring motor and starter operation for faults. If a fault is detected the control logic provides the fault indication visually on the display. Fault information is also made available through the communications port (Modbus RTU standard, other field busses optional).

2.3 PROGRAMMABLE MOTOR CONTROL FUNCTIONS

Starting Profiles

- TruTorque™ Torque Control
- kW Power Ramp
- Voltage Ramp
- Tach
- Dual Ramps
- Programmable Current Ramp
- Ramp to Limit
- Full Voltage Start

Stopping Profiles

- TruTorque™ Torque Control
- Fully Programmable "S" Curve Pump Decel
- Soft Stop
- DC Injection Brake

Interlocking/Logic

- Overload Lockout
- Assignable Digital Relay Outputs (6)
- Frequency Tracking
- Up to Speed Indication/Contact
- Programmable Digital Inputs (8)
- Fixed Digital Start Input (1)
- Analog Input
- 4-20mA Analog Output

Maintenance

- Emergency Restart After Fault Lockout
- Selectable CT Ratios
- Current Limited Slow Speed
- Real Text 99 Event Recorder with time and date stamp
- Soft Stop
- Standard BIST (built In Self Test)
- 9 event fault log with motor conditions at time of fault (Voltage, Current, Power)

Diagnostics Functions

- Alpha/Numeric Fault Display
- Motor Thermal % Capacity Display
- Closed Loop Motor Stall Detection
- Open Loop Motor Stall Detection
- Starter Status Indication
- Pre-Start: Pending Fault Indication
- Pre-Start: Phase Rotation Indication
- LED Indication SCR Status
- Full Screen Meter Mode
- BIST (Built in Self Test)

2.4 SERIAL COMMUNICATIONS PORT

The starter shall have an integral Modbus RTU (RS-485) communication interface.

The PC cards are the same and interchangeable between all starters.

Baud Rate

1.2 to 19.2 Kbps

Parity

None, Odd, Even

Network Capacity

Up to 128 nodes without a repeater (1/4 unit load)

Other Networks Available

Optional communication protocols interface modules shall be available for connection to Modbus/TCP, DeviceNet, EtherNet/IP, Profibus-DP and CANOpen. Further networks available through third-party gateway.

2.5 METER MONITORING

General

The solid state starter shall be capable of displaying the following:
The starter is supplied with a door-mounted LCD display. If the LCD Display malfunctions the CFMVRMX has an integrated 4X7 segment LCD display.

Accuracy

- CT Inputs: True RMS, Sampling @ 1.562kHz
- Line Voltage Inputs: True RMS
- Current: 0-40,000 Amps 3%
- Voltage: 0-15000 Volts 3%
- Watts: 0-9,999 MW 5%
- Volts-Amps: 0-9,999 MVA 5%
- Vars: 0-9,999 Mvar 5%
- Watt-Hours: 0-10,000 MWh 5%
- PF: -0.01 to +0.01 (Lag & Lead) 5%
- Line Frequency: 23-72 Hz 0.1 Hz
- Ground Fault: 5-100% FLA 5%
- Run Time: 3 seconds per 24-hour period
- Analog Input: Accuracy 3% of full scale
- Analog Output: Accuracy 2% of full scale
- Zero Sequence CT
- Range : 0.1A – 25 Arms
- Accuracy : 3%
- Burden at 25 Amps : 0.0089VA
- PTC

NOTE: Percent accuracy is percent of full scale of the given ranges, Current = Motor FLA Full Range, Voltage = 15000V, Watts/Volts-Amps/Watt-Hours = Motor & Voltage range.

Meters

The LCD meter display:

- Status
- Average Current
- Line 1 current.
- Line 2 current.
- Line 3 current.
- Current imbalance level
- Residual ground fault current
- Average voltage
- L1-L2 volts
- L2-L3 volts
- L3-L1 volts
- Overload
- Power factor
- Watts (Power)
- Zero Sequence GF
- Volt Amps
- VARS
- kW Hours (Energy)
- MW Hours (Energy)
- Phase Order
- Line Frequency
- Analog Input
- Analog Output
- Run Days
- Run Hours
- Starts
- TruTorque %
- Power %
- Maximum phase current
- RTD 1-16 (Optional)
- Peak Accel Current
- Last Start Time

2.6 STANDARD FEATURES

General

The MVRMX has these standard features:

- Three-phase operation
- Adjustable ramp time (0 - 300s)
- Adjustable initial current (50 - 600%)
- Adjustable maximum current (100 - 800%)
- Adjustable kick start (100 to 800% FLA, Off, 0.1 to 10 seconds)
- Selectable motor deceleration Control for Pumps (0 - 180s)
- Extreme current imbalance/line phase loss detection
- Adjustable line current imbalance protection (5 - 40%)
- 6 Programmable output contacts
- RTD Biases Overloads
- Line phase sequence sensitivity or insensitivity
- Phase loss and phase reversal protection
- Selectable solid state overload class (None or 1- 40)
- Independent starting and running overloads
- Negative sequence overload biasing
- Adjustable motor full load amps (1 - 6400A)
- Adjustable motor service factor (1.00 - 1.99)
- Adjustable current transformer ratio (50A, 150A, 250A, 800A, 2000A, 5000A), 5A secondary
- Adjustable stalled motor detection (0 - 900s)
- Operation at universal line voltage (2200 through 7200VAC, optional up to 13800VAC)
- Line frequency tracking (23Hz through 72Hz)
- 120VAC external trip input (fault detection active on start and UTS)
- Instantaneous overcurrent detection
- Overcurrent (jam) protection (Off or 50 - 800%, 0.1 to 90 seconds)
- Undercurrent protection (Off or 5 - 100%, 0.1 to 90 seconds)
- Shorted SCR detection and SCR condition indication
- 2 line, 16 character LCD display
- Programmable metering
- Variable voltage control input (0 to 5/10 volts, 0/4 to 20mA)
- 99 Record Event Log
- Real Time Clock
- PTC Thermistor Input
- Zero Sequence High Resistance Ground Fault Detection

Door Mounted Display

The MVRMX has standard, a door mounted display. The display will provide all of the functions of the circuit card mounted display plus an overload reset button. The door mounted display also has the ability to be remotely operated at distances up to 100', (a repeater may be necessary depending on installation conditions). This would allow operation and metering outside of most NFPA 70E Arc Flash Protection Zones.

LED Display

The four character, alphanumeric 4X7 LED display located on the control card displays:

- Starter status information
- Operating parameters
- Condition codes
- Fault codes
- Thermal Overload Content
- Metering
- Remote display active
- Alarm

LED indicators

Each starter will have indicating LEDs for:

- Power On / Heartbeat
- Communication
- Receive
- Transmit
- Phase Condition
- RTD Module (Optional)
- Fiber Optic Firing

Serial Communication Port

Via an RS-485 serial communications port, the RediStart MVRMX will communicate using Modbus RTU protocol at 1200, 2400, 4800, 9600 or 19.2kbps. This can be used for remote start/stop and/or starter status information.

2.7 KEYPAD & DISPLAY

General

Each starter shall have a door mountable keypad/display module designed to:

- Set or examine operating parameters
- Provide status information
- Provide real time information about line current, voltage, overload, and frequency
- Provide a means to start and stop the solid state starter
- Provide full fault annunciation (fault code and description)

Integral LED Display & Keypad

- 4x7 high brightness LED display
- Parameter Pushbutton
- Down Pushbutton and motor thermal overload content display toggle
- Up Pushbutton and incoming line phase order display toggle
- Enter Pushbutton and status meter (rdY, run, utS, dcL,etc) display toggle
- Reset Pushbutton

LCD Display & Keypad

- 2x16 high contrast door-mounted LCD display
- Stop/Reset Pushbutton
- Start Pushbutton
- Menu Pushbutton
- Enter Pushbutton
- Up Arrow Pushbutton
- Down Arrow Pushbutton
- Left Arrow Pushbutton
- Stop, Alarm and Run LED Indicators
- Running, Alarm and Fault LED Indicators

Display is IP65 Class 1, Division 2 rated (NEMA 3R). A NEMA 4 display cover is optional.

NOTE: All pushbuttons have tactile feedback.

2.8 PROGRAMMABLE MOTOR PROTECTION FUNCTIONS

Motor/Machine Faults

- Selectable solid state overload class (None or 1- 40)
- Independent starting and running overloads
- Motor PTC thermistor trip time
- Motor overload hot/cold ratio
- Motor overload cooling time
- Motor overload alarm level
- Motor overload lockout level
- Motor overload auto lockout level
- RTD overload biasing
- Backspin timer
- Auto fault reset counter limit
- Speed switch trip time
- Residual Ground Fault Protection
- Zero Sequence Ground Fault Protection
- Overload Warning
- Acceleration Time
- Instantaneous Overcurrent
- Motor Thermal Capacity Protection
- Extreme current imbalance/line phase loss detection
- Adjustable line current imbalance protection (Off, 5 - 40%)
- Line phase sequence sensitivity or insensitivity
- Phase loss and phase reversal protection
- Negative sequence overload biasing
- Adjustable motor service factor (1.00 - 1.99)
- Adjustable stalled (jammed) motor detection (0 - 900s)
- Auto Reset (sets the time delay after a fault)
- Time between Restarts
- Controlled fault stop

Electrical System Faults

- Overcurrent (jam) protection (Off or 50 - 800%, 0.1 to 90 seconds) Selectable Trip or Warning)
- Undercurrent protection (Off or 5 - 100%, 0.1 to 90 seconds) Selectable Trip or Warning)
- Overvoltage (Off, 1 - 40%)
- Undervoltage (Off, 1-40%)
- Voltage trip time (0.1 - 90 sec.)
- Shorted SCR detection and SCR condition indication

Power Fuses (Optional)

- Current limiting type R rated 50KAIC symmetrical at max. 7200V.
- Fuse size shall be manufacturer's standard.
- Fuses shall be vertically mounted in the front of the enclosure for ease of inspection and removal without special tools.
- Provide blown fuse indication.
- Power fuse holders shall be part of starter assembly.

2.9 RESIDUAL GROUND FAULT

The starter shall have integral to its design residual Holmgreen ground fault protection. The starter monitors the instantaneous sum of the three line currents to detect ground fault current.

This Holmgreen method is best suited for use on either solidly grounded power systems or those grounded through a low impedance. The trip setting has an available range or 5 - 100% of the motors full load current setting.

2.10 ZERO SEQUENCE GROUND FAULT PROTECTION EQUIPMENT

Zero Sequence Ground Fault Protection is to be used on isolated or High resistance grounded systems.

- Ground Fault CT
- CT Type-> 50:0.025 (2000:1 ratio)
- Measurement range-> 0.1A - 25.0 Arms
- Accuracy -> +/- 3%
- Burden at 25Amps -> 0.0089VA

2.11 DIGITAL INPUTS

The digital inputs shall be configurable to one of the following:
-2 Fixed: Start and Bypass Confirm
-8 Programmable

- Off
- Stop
- Fault High
- Fault Low
- Fault Reset
- Disconnect
- Inline Confirm
- Bypass Confirm
- EOL Reset
- Local/Remote
- Heat Disable
- Heat Enable
- Ramp Select
- Slow Speed Forward (Cyclo-converter Control)
- Slow Speed Reverse (Cyclo-converter Control)
- Brake Disable
- Brake Enable
- Speed Switch Normally Open
- Speed Switch Normally Closed

2.12 PROGRAMMABLE RELAY OUTPUTS

General

The MVRMX provides six relay output contacts. Relays R1, R2, R4, R5, R6 are programmable outputs, which may be programmed according to the list below. The relay contacts are rated form C, 5 amp, resistive, 125VAC and 3 amp, resistive, 250VAC.

R3 is for Inline contactor operation. R3 relay contacts are rated form C, 16 amp, resistive, 120VAC, 16 amp, resistive, 30VDC and 1HP, 240VAC.

General Fault Relay

The General Fault contact energizes when any motor or starter fault is detected. These faults include the following:

- No fault
- UTS Time Limit Expired
- Motor Thermal Overload Trip
- Jog Time Limit Expired
- Phase Rotation Error, not ABC
- Phase Rotation Error, not CBA
- Low Line Frequency
- High Line Frequency
- Input power not single phase
- Input power not three phase
- Low Line L1-L2
- Low Line L2-L3
- Low Line L3-L1
- High Line L1-L2
- High Line L2-L3
- High Line L3-L1
- Phase Loss
- No Line
- I.O.C.
- Overcurrent
- Undercurrent
- Current Imbalance
- Ground Fault
- No Current at Run
- Shorted / Open SCR
- Current at Stop
- Stack Protection Fault (stack thermal overload)
- Bypass Contactor Fault
- Control Power Low
- Current Sensor Offset Error
- External Fault on DI 1 Input
- External Fault on DI 2 Input
- External Fault on DI 3 Input
- Analog Input #1 Level Fault Trip (local)
- SPI Communication Fault
- Modbus Timeout Fault
- CPU Error - SW fault
- CPU Error - Parameter EEPROM Checksum Fault
- CPU Error
- CPU Error - SW Watchdog
- CPU Error
- CPU Error - Program EPROM Checksum Fault

Relay Configurations:

- OFF
- Fault (fail safe)
- Fault (Non Fail Safe)
- Running
- Up to Speed
- Alarm
- Ready
- Locked Out
- Overcurrent
- Undercurrent
- Overload Alarm
- Cool Fan Control
- Shunt Trip (Fail safe)
- Shunt Trip (Non fail safe)
- Ground Fault
- Energy Saver
- Heating
- Slow Speed (Cyclo-converter)
- Slow Speed Forward (Cyclo-converter)
- Slow Speed Reverse (Cyclo-converter)
- DC Injection Braking
- PORT (Power Outage Ride Thru)
- Tach Loss

2.13 ANALOG INPUT

The analog input is the reference input for the starter configured as a Phase Controller or Current Follower. In addition, the Analog Input Trip Type parameter allows the user to set a high or low comparator based on the analog input.

- 0-5/10VDC
- 0/4-20mADC

2.14 ANALOG OUTPUT

The analog output function can be configured to one of the available output function selections and output scaling shown below. The analog output is updated every 25msec.

- Off
- 0-200% Curr.
- 0-800% Curr.
- 0-150% Volt.
- 0-150% OL
- 0-10 kW
- 0-100 kW
- 0-1 MW
- 0-10 MW
- 0-100% Ain
- 0-100% Firing
- Calibration

2.15 BIST (BUILT IN SELF TEST)

- The starter must contain a built in self-test (BIST) feature that has the capability to perform a test sequence to ensure it is operating properly while isolating test personnel from high voltages.
- BIST must provide proper interlocking to assure that the test can be done only when not in service.
- BIST must operate the contactors to verify proper operation. It must alarm through the integral LCD display if the sequence fails.
- BIST must allow operator to verify SCR gate firing of all SCRs within the starter and offer the ability to measure the gate voltage with a DC voltmeter.
- BIST must provide control power to all auxiliary devices to allow verification of proper operation of each of these devices.

2.16 PORT (POWER OUTAGE RIDE THRU)

The Starter can be furnished with the ability to ride through short-term power losses of up to 90 seconds duration without shutdown and/or dropout of internal control logic, an uninterruptible power supply is required.

2.17 ADVANCED FUNCTIONS

- The starter shall have the following advanced features:
- Reset Run Time
- Reset kW/MWH
- Reflash Mode
- Store Mode
- Load Parameters
- Emergency Overload Reset
- Factory Reset

2.18 MAIN & BYPASS CONTACTORS

Inline (main) contactor and a bypass contactor shall be provided.

- Full NEMA rated (IEC rated contactors cannot be accepted).
- Current ratings: manufacturer standard for horsepower rating.
- Voltage rating: Up to 13800VAC.
- The main and/or bypass contactor shall be sequenced by the starter manufacturer for proper operation of the solid state starter.

2.19 CONTROL DEVICES

Control Power Transformer (Optional)

Provide an appropriately rated internal 2100-7200V - 120VAC step-down transformer.
Supply two fuses on primary and one fuse on secondary side with one leg grounded.

Control Wiring

Minimum 14 AWG stranded, rated for 600V 105ºC.

Terminal Strips

Rated for 600V, suitable for contractor termination of up to 10 AWG wire.

Others

Push buttons, pilot lights, and control relays, heavy duty, rated to 600V.

2.20 LOGIC CONTROL

User Interface Module

Provide a door mounted Display & User Interface Module with the following functions:

- Backlit LCD- 2 Lines, 16 Characters (NEMA/CEMA 4 Rated)
- Tactile Feedback Buttons
- Pass Code Protection
- Built in Start/Stop/Reset Pushbuttons
- Status Indications via LCD Display and LED's
- Scrolling Menu/Parameters
- Discrete Enter Command Button
- Meter Mode Display
- Main Display Hot Key

3 MECHANICAL SPECIFICATIONS

3.1 OPTIONAL FEATURES

Optional Features

Other protective devices and metering equipment may be supplied with the MVRMX. These other devices will depend on the system configuration and specific customer requirements. Standard overload protection is provided by means of three-phase solid-state thermal overload relays. As an option, the overload relays can be bi-metallic, ambient compensated and operated through current transformers.

RediStart MX^3 Combination Starter

The structure shall consist of a metal enclosed dead front vertical steel assembly. It shall contain:

- RediStart MVRMX solid state starter
- A main isolation switch (fused disconnect, circuit breaker, or molded case switch)
- Optional control power transformer with fusing
- Optional bypass contactor and/or inline contactor
- Other optional devices required by the end user

Control Power Transformer

The RediStart MVRMX can be provided with a control power transformer. The transformer will usually be sized for the power requirements of the starter but can also be sized to provide power for customer controls.

RTD Monitoring Package

The RediStart MVRMX can be provided with an optional RTD monitoring package. This package is capable of monitoring up to 16-100 ohm platinum RTDs. Each RTD can be assigned as a bearing, stator or general RTD with separate alarm and trip set point. The RTD module can be remotely mounted at the motor to eliminate the long costly runs of RTD wiring to the starter enclosure.
Some Features include:
RTD Bias the Overload
RTD Bias Minimum Level
RTD Bias Mid Point Level
RTD Bias Maximum Level

Linear Acceleration

The RediStart MVRMX can be provided with a linear acceleration control option. This option uses a tachometer feedback from the motor shaft. With the feedback, the RediStart MVRMX will linearly accelerate the motor.

Optional Protection Systems

In addition to the standard overload protection, the following systems are available for added motor and system protection:

- Over and Under Voltage Relays
- Voltage Unbalance Sensors
- Current Unbalance Sensors (Note, this sensor also detects single-phase fault conditions)
- Ground Fault Relays
- Motor Protection Systems (i.e. Benshaw RTD Monitor)
- Optional Metering Systems

Metering Packages

The starter can be equipped with any optional metering packages including the following:

- Single phase Voltmeter and Ammeters
- Three-phase Voltmeters and Ammeters
- Power Factor Meters
- Metering Packages (i.e. Multilin , etc.)

The metering packages include all the necessary CTs and CPTs required for interface to the incoming line power.

Other Options

Benshaw can build custom starter packages for special applications. Contact your local Benshaw representative with a description of the application.

3.2 UL /CUL SHORT CIRCUIT/WITHSTAND RATINGS

All Benshaw MVRMX starters have a Short Circuit Current Withstand Rating of 50KARMS.

3.3 MECHANICAL CONSTRUCTION

Enclosure Construction

- Construct to comply with NEMA Part ICS 2.
- Basic structure shall be welded type construction utilizing minimum 11 GA sheet metal.
- Doors shall be minimum 12 GA sheet metal, pan type with flanges formed to provide sturdy, rigid structure.
- Door latches and hinges capable of holding door closed during maximum fault condition. Provide door interlocks to prevent doors from being opened with power applied. Provide removable lifting provisions on floor mount enclosures.
- Finish:
- Metal parts to be given thorough rust resistant treatment.
- Primer shall be S-W recoatable epoxy primer B-67 Series
- Finish shall be S-W high solid polyurethane polate T plus F63 series
- Color shall be ANSI 61 Gray unless otherwise specified.
- Complete with internal power and control wires including terminations for external connections. Phase sequencing shall have proper identification and control wires shall have suitable markings at terminations.

SCR Stacks

- Arranged for proper heat management.
- Heat sinks sized for specified Starts Per Hour without requiring auxiliary cabinet cooling fans.

Starter Construction

The three-phase starter contains 3 SCR power section with multiple SCRs per phase connected in inverse parallel. The power section is capable of providing maximum torque per amp throughout the motor's speed-torque curve with minimal motor and starter heating.

The starter will be supplied as a chassis or in an enclosure. Enclosures are available in NEMA 1, NEMA 12 or NEMA 3R configurations.

Mechanical Layout

The Benshaw MVRMX consists of the following major components:

- Line and load lugs or pads sized to accommodate power wire rated at 125% of continuous current per the National Electrical Code at 75^{o}C
- A three section SCR power section with DV/DT snubber protection
- Control circuit board
- Provisions for two- or three-wire 120VAC (optional 240VAC) control
- Current transformers for line current feedback to the control board

The MVRMX incorporates natural convection cooling

Seismic Qualifications

The enclosures are designed and manufactured to meet the Uniform Building Code section on Non-building structures, section 2238 for Zone 1, 2, 3 and 4 requirements.

4 ENVIRONMENTAL SPECIFICATIONS

Operating Requirements

The MVRMX is designed to operate in the following conditions;

- Ambient Temperature: 0 C (32°F) to 40 C (122 F)
- Humidity (non-condensing): 0% to 95%

Storage Requirements

The MVRMX starter may be stored for up to two years before being installed. However, starter power terminations should be connected to full line voltage for one hour per year to maintain the voltage rating on the electrolytic capacitors. This will prevent short circuits when the system is powered up.

If the starter is to be stored, the following recommendations apply:

- Storage Temperature: -20 C (-4 F) to 70 C (158 F).
- Temperature Rate of Change: 6 C in 30 minutes
- Humidity (non-condensing): 0% to 95%.
- Humidity Rate of Change: 10% in 30 minutes

Operating Altitude

The operating altitude shall not exceed 3,300 feet (1000 meters) above sea level without de-rating.

Operating Orientation

Any orientation

Pollution Degree IEC 60947-1

3

Shock Resistance

15g in any direction

Vibration Resistance

MIL-STD-810, Category 4

5 BENSHAW QUALITY

5.1 QUALITY INSPECTION

Quality Inspection

All incoming material will be inspected and/or tested for conformance to quality assurance specifications. Power semiconductors will be fully tested for proper electrical characteristics (dv/dt, di/dt, etc).
All subassemblies will be inspected and/or tested for conformance to vendors engineering and quality assurance specifications. The completed unit will be functionally tested before shipment to assure proper operation per this specification.

5.2 START-UP SERVICE

Start-Up Service

Benshaw provides complete field support for initial startup of the RediStart MVRMX starters. In most cases the engineering staff responsible for in-house testing will also be assigned to follow the unit into the field for startup assistance. Fees for start-up assistance may be obtained from the current Benshaw Solid State Motor Control catalog.

This assistance is available on a daily basis and complete technical support is provided upon request. Additionally, telephone technical support is available to all customers at no charge.

5.3 TRAINING

Training

As requested, Benshaw will supply a quotation for on-site or factory training on its RediStart MVRSX starters. This training will provide operating and instruction manuals, training on equipment operation and troubleshooting of the Benshaw equipment.

5.4 DOCUMENTATION

Documentation

Benshaw starters are shipped with a complete set of documentation that typically includes the following items:

- Complete schematics and wiring diagrams
- Instruction Manuals
- Contactor and Disconnect System Data if applicable

If required, special documentation can also be provided. This documentation may include component layout drawings, wiring diagrams, and system interconnect schematics. All drawings and documentation are done in AutoCAD and Microsoft Word and are available to customers on CDs or via e-mail.

Revision History:

Revision	ECO#	Description	Approval	Date
00		Initial Release		Dec. 2006
01		Optional Feature adjustment		Dec. 2006

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