



**BENSHAW**  
Applied Motor Controls

# Product Catalog



JANUARY 2024 EDITION

## Medium Voltage Products

*Rapid | Rugged | Global*



Benschaw standard products are stocked in warehouses in the USA and Canada ... ready for shipment to support your critical needs.

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#### VISIT US ONLINE:

[www.Benschaw.com](http://www.Benschaw.com)

USA WEBSTORE ...

## [BenschawExpress.com](http://BenschawExpress.com)

CANADIAN WEBSTORE ...

## [BenschawExpress.ca](http://BenschawExpress.ca)

Benschaw Express is a convenient, time-saving tool for Benschaw authorized distributors. Our webstore provides 24/7/365 access to ...

- Check product pricing and availability
- Place and track orders for standard products (soft starters, variable frequency drives, full voltage controls, molded case circuit breakers, pilot devices, parts and accessories)
- Configure packaged products
- View recent orders
- And more ...

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# Introduction

## *Benshaw ... Right from the Start*

Benshaw is the trusted expert for any AC motor application. Benshaw provides a full line of application solutions for motors ranging from 2.3 through 15kV Class up to 25,000 HP. Applications for our medium voltage product line range from pumps, compressors and chillers to fans and blowers, crushers, chippers and conveyors; for every motor type: Induction, synchronous, two-speed, reversing, wound rotor and more.

### **Pre-Packaged Products**

Benshaw offers an extensive range of integrated, programmable, NEMA Class E2, combination starters. Our patented, UL listed medium voltage motor control solutions include control and power electronics, bypass and isolation contactors and a fusible load break switch to reduce maintenance and operating costs.

### **Custom-Engineered Solutions**

Benshaw offers an extensive array of custom engineering and project management capabilities, from power system studies to design consultation, installation and commissioning services. With millions of hours of accumulated custom engineering experience, Benshaw can deliver the custom-engineered medium voltage motor control system you need, with all of the convenience and value you'd expect from the world's leader in applied motor control solutions.

Our medium voltage motor control solutions include:

- MV Soft Starters
- Full Voltage Assemblies
- MV Switchgear Assemblies
- Lineups/Motor Control Centers
- MV Variable Frequency Drives
- IEC Motor Controls
- Specialty Products
- Projects



## **SECTION 1**

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## MVRNX SERIES

Next level NX technology takes motor control into the future delivering all the functionality and rugged, dependable performance that you've come to expect from a Benshaw product, while allowing wireless connectivity, seamless troubleshooting, advanced monitoring, and even more configurable options. The NX controller comes standard with cyber secured Bluetooth capabilities allowing you to seamlessly and safely connect to your equipment through a phone app to shorten commissioning times and improve troubleshooting.

The NX controller has been designed to meet global standards and is RoHS compliant.

The PLC type architecture of the controller allows for options to be easily integrated into the system, and the upgraded HMI shows wave forms and data sampling to quickly troubleshoot any issues to get the system back up and running.

### Ratings from 2300V -4160V up to 3000HP

Robust design for standard and heavy duty applications.

### Bus Designs

UL tested bus design up through 2000A.

### Unique Features:

- Bluetooth interface using phone apps for iPhone and Android
- RNX controller can handle two (2) motors each with separate parameters and overload protection
- USB port for downloading waveform capture data

***“A generational change in processor speed, protection/monitoring functionality and communications capabilities.”***



New Low Voltage Compartment

# MVRNX SERIES - FEATURES

## KEY FEATURES

- **Expandable system**
  - HMI with full-color display (panel-mount)
  - DIN rail-mounted control modules
  - Additional DIN rail-mounted modules (can be connected via CAN bus to expand the system and provide additional features)
- **Built-in connectivity**
  - Bluetooth Low Energy (BLE) wireless connection to mobile app
  - Built-in Modbus RTU
  - 6 x digital inputs
  - 4 x relay outputs
  - Analog output with digital offset and span adjustment
  - USB-A socket
  - CAN bus-based expansion to other modules
- **Easy to understand interface**
  - Plain text menus and displays
  - Color-coded status bar
  - Informative on-screen metering
  - Real-time clock
  - Programmable metering
  - Resettable run time and power consumption metering
- Multi-language menus and displays
- Passcode protection
- **Versatile starting/stopping options**
  - Constant current
  - Current ramp
  - Voltage ramp
  - TrueTorque ramp
  - Power ramp
  - 2 and 3 wire start/stop control
- **Customizable protection**
  - Motor overload (thermal model)
  - Undercurrent/Overcurrent
  - Underpower/Overpower
  - Undervoltage/Overvoltage
  - Current imbalance
  - Stalled motor protection (Excess start time /UTS)
  - Line frequency
  - Phase sequence
  - Phase loss (single phasing)
  - Power factor leading/lagging
  - Residual or zero-sequence ground fault protection
  - Backspin/restart timer
  - Starts per hour
  - Time between starts
- Power outage ride-through
- **Motor control modes**
  - Soft start - supports two motor sets
  - Smart ATL - injection test compatible
  - Smart Wye/Delta
  - Power loss ride-through
  - Emergency mode
- **Commissioning/troubleshooting tools**
  - Extensive trip and event logging
  - Versatile trip actions
  - High-speed waveform capture during start, stop and faults
  - Self-test and run simulation mode
- **Cybersecurity**
  - PIN number protection
  - Digitally signed firmware
  - Secure Bluetooth pairing
- **Optional expansion modules**
  - 8 or 16 RTD inputs, with overload biasing
  - Ethernet/IP
  - CAN bus isolation
  - Profinet (coming 2024)
  - Profibus (coming 2024)



## MVRNX SERIES - PRICING

### STANDARD DUTY

#### 2300 V

Model Number	Volts	Standard Duty		Dimensions (in.)			Approx. Weight (lbs.)
		HP	FLA	H	W	D	
CFMVRNX12-150-2300**	2300	150	36	92.5	36	30	430
CFMVRNX12-500-2300**	2300	500	120	92.5	36	30	430
CFMVRNX12-750-2300**	2300	750	180	92.5	36	30	430
CFMVRNX12-1000-2300**	2300	1000	240	92.5	36	30	430
CFMVRNX12-1250-2300**	2300	1250	300	92.5	36	30	430
CFMVRNX12-1500-2300**	2300	1500	360	92.5	36	30	430
CFMVRNX12-2000-2300**(1)	2300	2000	453	92.5	96	36	430
CFMVRNX12-2500-2300**(1)	2300	2500	566	92.5	96	36	430
CFMVRNX12-3000-2300**(1)	2300	3000	679	94	159	50	430

Standard duty = 350% current for 30 seconds.

(1) Units not configured with bus through all enclosure sections.

\*\* Insert appropriate option code as shown below:

NEMA 1 = 1

NEMA 12 = 12

NEMA 3R = 3R

Coming soon

#### 3300 V

Model Number	Volts	Standard Duty		Dimensions (in.)			Approx. Weight (lbs.)
		HP	FLA	H	W	D	
CFMVRNX12-300-3300-**	3300	300	51	92.5	36	30	430
CFMVRNX12-750-3300-**	3300	750	127	92.5	36	30	430
CFMVRNX12-1000-3300-**	3300	1000	169	92.5	36	30	430
CFMVRNX12-1250-3300-**	3300	1250	211	92.5	36	30	430
CFMVRNX12-1500-3300-**	3300	1500	254	92.5	36	30	430
CFMVRNX12-2000-3300-**	3300	2000	338	92.5	36	30	430
CFMVRNX18-2500-3300-**(1)	3300	2500	395	92.5	96	36	2800
CFMVRNX18-3000-3300-**(1)	3300	3000	473	92.5	96	36	2800
CFMVRNX18-3500-3300-**(1)	3300	3500	552	92.5	96	36	2800
CFMVRNX18-4000-3300-**(1)	3300	4000	631	94	159	50	2800
CFMVRNX18-4500-3300-**(1)	3300	4500	710	94	159	50	2800

Standard duty = 350% current for 30 seconds.

(1) Units not configured with bus through all enclosure sections.

\*\* Insert appropriate option code as shown below:

NEMA 1 = 1

NEMA 12 = 12

NEMA 3R = 3R

Coming soon





# MVRNX SERIES - PRICING

## STANDARD DUTY

### 4160 V

Model Number	Volts	Standard Duty		Dimensions (in.)			Approx. Weight (lbs.)
		HP	FLA	H	W	D	
CFMVRNX18-300-4160**	4160	300	40	92.5	36	30	2800
CFMVRNX18-750-4160**	4160	750	99	92.5	36	30	2800
CFMVRNX18-1000-4160**	4160	1000	133	92.5	36	30	2800
CFMVRNX18-1250-4160**	4160	1250	166	92.5	36	30	2800
CFMVRNX18-1500-4160**	4160	1500	200	92.5	36	30	2800
CFMVRNX18-2000-4160**	4160	2000	266	92.5	36	30	2800
CFMVRNX18-2500-4160**	4160	2500	333	92.5	36	30	2800
CFMVRNX18-3000-4160**	4160	3000	360	92.5	36	30	2800
CFMVRNX18-3500-4160**(1)	4160	3500	466	92.5	96	36	2800
CFMVRNX18-4000-4160**(1)	4160	4000	532	92.5	96	36	2800
CFMVRNX18-4500-4160**(1)	4160	4500	600	92.5	96	36	2800
CFMVRNX18-5000-4160**(1)	4160	5000	626	94	159	50	2800
CFMVRNX18-5500-4160**(1)	4160	5500	688	94	159	50	2800

Standard duty = 350% current for 30 seconds.

(1) Units not configured with bus through all enclosure sections.

\*\* Insert appropriate option code as shown below:

NEMA 1 = 1

NEMA 12 = 12

NEMA 3R = 3R

Coming soon

COMING SOON

# MVRNX SERIES - PRICING

## HEAVY DUTY

### 2300 V

Model Number	Volts	Heavy Duty		Dimensions (in.)			Approx. Weight (lbs.)
		HP	FLA	H	W	D	
CFMVRNX12-150-2300-**	2300	150	36	92.5	36	30	430
CFMVRNX12-500-2300-**	2300	500	120	92.5	36	30	430
CFMVRNX12-750-2300-**	2300	750	180	92.5	36	30	430
CFMVRNX12-1000-2300-**	2300	1000	240	92.5	36	30	430
CFMVRNX18-1500-2300-**(1)	2300	1500	360	92.5	96	36	2800
CFMVRNX18-2000-2300-**(1)	2300	2000	453	92.5	96	36	2800
CFMVRNX18-2250-2300-**(1)	2300	2250	509	94	159	50	2800

Heavy duty = 500% current for 30 seconds.

(1) Units not configured with bus through all enclosure sections.

\*\* Insert appropriate option code as shown below:

NEMA 1 = 1

NEMA 12 = 12

NEMA 3R = 3R

Coming soon

### 3300 V

Model Number	Volts	Heavy Duty		Dimensions (in.)			Approx. Weight (lbs.)
		HP	FLA	H	W	D	
CFMVRNX12-300-3300-**	3300	300	51	92.5	36	30	430
CFMVRNX12-750-3300-**	3300	750	127	92.5	36	30	430
CFMVRNX12-1000-3300-**	3300	1000	169	92.5	36	30	430
CFMVRNX12-1250-3300-**	3300	1250	211	92.5	36	30	430
CFMVRNX12-1500-3300-**	3300	1500	254	92.5	36	30	430
CFMVRNX18-2000-3300-**(1)	3300	2000	338	92.5	96	36	2800
CFMVRNX18-2500-3300-**(1)	3300	2500	295	92.5	96	36	2800
CFMVRNX18-3000-3300-**(1)	3300	3000	473	92.5	96	36	2800
CFMVRNX18-3500-3300-**(1)	3300	3500	552	94	159	50	2800
CFMVRNX18-4000-3300-**(1)	3300	4000	631	94	159	50	2800
CFMVRNX18-4500-3300-**(1)	3300	4500	710	94	159	50	2800

Heavy duty = 500% current for 30 seconds.

(1) Units not configured with bus through all enclosure sections.

\*\* Insert appropriate option code as shown below:

NEMA 1 = 1

NEMA 12 = 12

NEMA 3R = 3R

Coming soon

# MVRNX SERIES - PRICING

## HEAVY DUTY

### 4160 V

Model Number	Volts	Heavy Duty		Dimensions (in.)			Approx. Weight (lbs.)
		HP	FLA	H	W	D	
CFMVRNX18-300-4160-**	4160	300	40	92.5	36	30	2800
CFMVRNX18-750-4160-**	4160	750	99	92.5	36	30	2800
CFMVRNX18-1000-4160-**	4160	1000	133	92.5	36	30	2800
CFMVRNX18-1250-4160-**	4160	1250	166	92.5	36	30	2800
CFMVRNX18-1500-4160-**	4160	1500	200	92.5	36	30	2800
CFMVRNX18-2000-4160-**	4160	2000	266	92.5	36	30	2800
CFMVRNX18-2500-4160-**(1)	4160	2500	333	92.5	96	36	2800
CFMVRNX18-3000-4160-**(1)	4160	3000	360	92.5	96	36	2800
CFMVRNX18-3500-4160-**(1)	4160	3500	466	92.5	96	36	2800
CFMVRNX18-4000-4160-**(1)	4160	4000	532	94	159	50	2800

Heavy duty = 500% current for 30 seconds.

(1) Units not configured with bus through all enclosure sections.

\*\* Insert appropriate option code as shown below:

NEMA 1 = 1

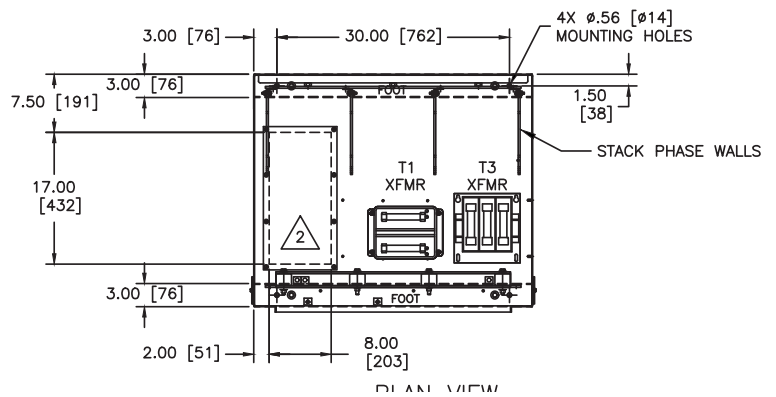
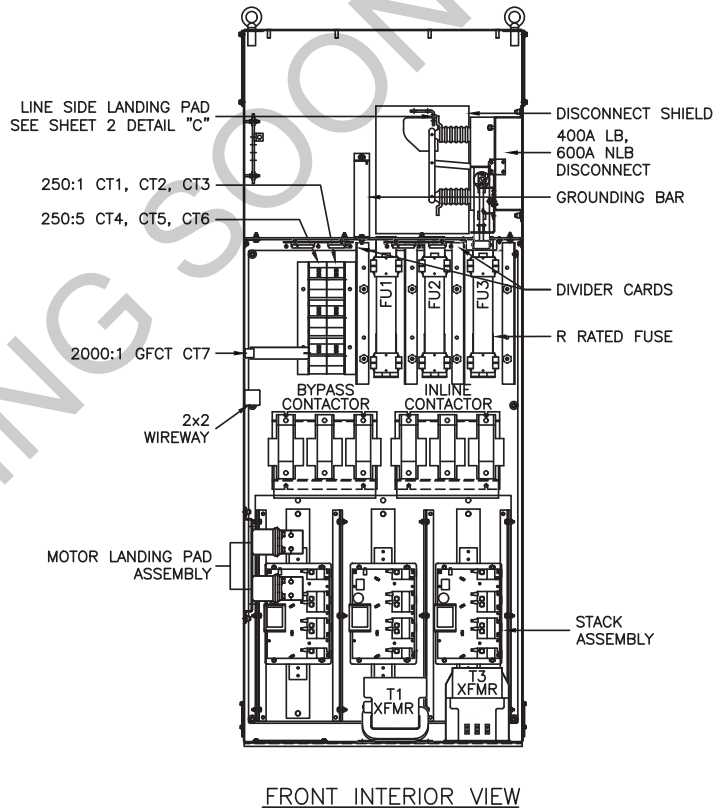
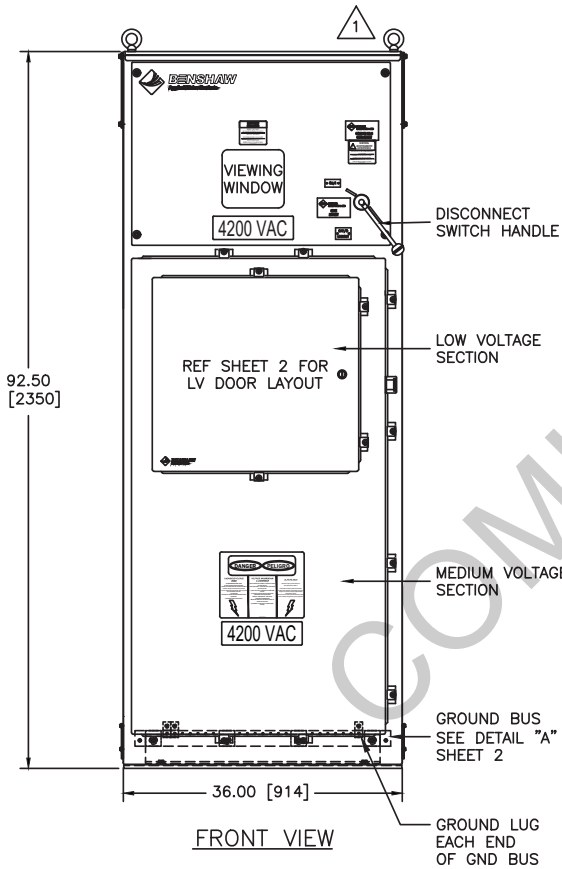
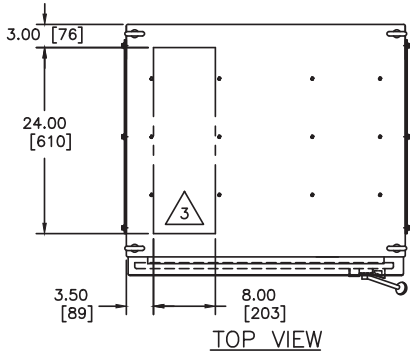
NEMA 12 = 12

NEMA 3R = 3R

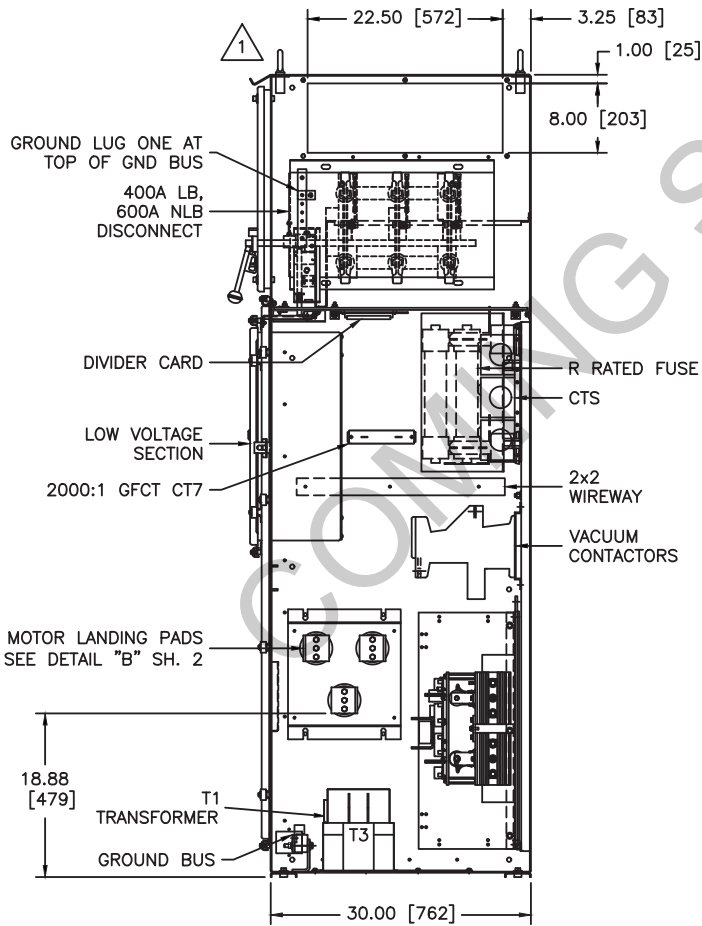
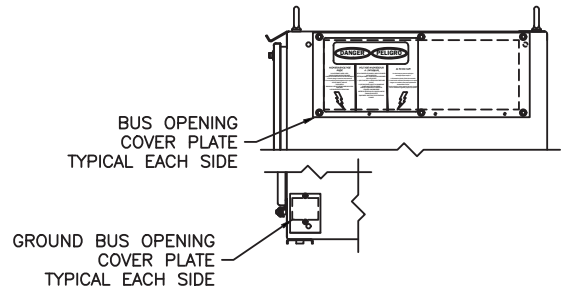
Coming soon

COMING SOON

# MVRNX SERIES - DRAWINGS



# MVRNX SERIES - DRAWINGS



RIGHT SIDE INTERIOR VIEW

NOTES:

- 1 REMOVABLE LIFTING EYEBOLTS
- 2 CABLE ENTRY/EXIT AREA. CUTOUT W/ COVER PLATE SUPPLIED
- 3 CABLE ENTRY/EXIT AREA. NO CUTOUT SUPPLIED. CUSTOMER TO CUT AS REQUIRED.
- 4. ENCLOSURE COLOR: ANSI 61 GREY
- 5. TIGHTEN BOLTS PER CHART BELOW

# MVRXE SERIES



Benschaw’s MVRXE Series sets the industry standard for performance and reliability.

## Class E2 Severe Duty Starter with Load Break Fusible Disconnect and Emergency ATL Bypass.

### KEY ADVANTAGES:

- NEMA 12 or NEMA 3R
- 45 kV BIL
- Built-in self test (BIST) features for “quick commissioning”
- Switch-selectable emergency back-up full voltage starter
- MX<sup>3</sup> embedded digital control
- UL 347 certified and listed

### STANDARD FEATURES:

- 50 kA (4800 VAC) / 50 kA (2600 VAC) withstand rating
- 500%-30 seconds rated solid state starter
- “R” class fusing protection
- Door-mounted controls
- Modbus communications standard
- Service entrance rated

### MVRXE12 - 2300 V

Model Number	HP	Dimensions (in.)				Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
		A	H	W	D			
MVRXE12-550-2300**	550	131	92	36	32	1,800	\$53,440	\$57,267
MVRXE12-750-2300**	750	200	92	36	32	1,800	\$55,187	\$59,052
MVRXE12-900-2300**	900	225	92	36	32	1,800	\$56,899	\$60,823
MVRXE12-1500-2300** †	1500	360	92	36	32	1,800	\$62,785	\$67,812

### MVRXE18 - 4160 V

Model Number	HP	Dimensions (in.)				Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
		A	H	W	D			
☞MVRXE18-1000-4160**	1000	131	92	36	32	2,000	\$58,161	\$61,939
☞MVRXE18-1500-4160**	1500	200	92	36	32	2,000	\$60,405	\$63,773
☞MVRXE18-1700-4160**	1700	225	92	36	32	2,000	\$64,748	\$68,235
☞MVRXE18-3000-4160** †	3000	360	92	36	32	2,000	\$70,756	\$74,680

Starters are top entry/bottom exit – Dimensions and weights are approximate.

\*\* Insert appropriate option code as shown: NEMA 12 = 12 / NEMA 3R = 3R

† 350% for 30 seconds at max rating (360A)

☞ Web stocked.

### MODULAR OPTIONS

Option	Description	List Price
A	8-Channel RTD Module, 100 ohm Platinum (Also Available for Remote Mounting)	\$3,830
B	16-Channel RTD Module, 100 ohm Platinum (Also Available for Remote Mounting)	\$6,500
C	Ground Fault CT, 2000:1, 4.0:dia. (For MX <sup>3</sup> Use)	\$2,000

### NOTE:

Power fuses ship loose. Must provide motor full load amps at time of order for proper fuse sizing. Contact factory for additional options and accessories.

# MVRXE SERIES - SPARE PART KITS

Want to Minimize Downtime Loss of Production?

## Recommended Spare Parts Kits Include the Following:

- Power phase/stack assembly (x1)
  - Includes the following packaged heat sink assembly:
    - Fiber optic SCR firing card
    - SCRs (x6)
    - DVDT filter cards (x3)
- Main control board
- Voltage divider board
- “R” class line fuses (x3)
- Primary fuses for CPT (x2)
- Secondary fuses for CPT (x3)
- Door-mounted keypad
- Door-mounted pilot lights, pushbuttons and switches
- Overload relay
- Control relays



### 1000 HP STARTERS (4160V)

Model Number	Motor Amps	List Price
MVRXE-400101-SP	46 to 55 A	\$12,588
MVRXE-400102-SP	56 to 75 A	\$12,694
MVRXE-400103-SP	76 to 90 A	\$13,046
MVRXE-400104-SP	91 to 131 A	\$14,680

### 1700 HP AND 3000 HP STARTERS (4160V)

Model Number	Motor Amps	List Price
MVRXE-400107-SP	46 to 55 A	\$15,454
MVRXE-400108-SP	56 to 75 A	\$15,820
MVRXE-400109-SP	76 to 90 A	\$16,189
MVRXE-400110-SP	91 to 131 A	\$16,608
MVRXE-400111-SP	132 to 180 A	\$18,326
MVRXE-400112-SP	181 to 270 A	\$18,733
MVRXE-400113-SP	271 to 360 A	\$19,132

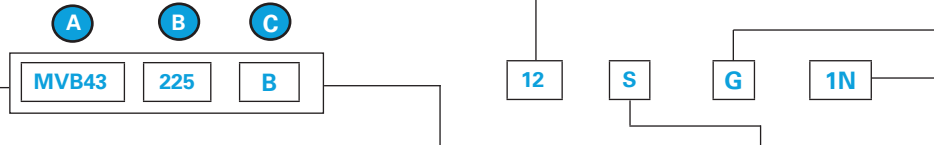
\*For amperage or voltage range not shown, consult factory.

# Design Your Customized Quick-Ship

Only one option can be selected from each group, with the exception of the "Control Options" section.

Add the appropriate code for the options chosen to the code string across the center of the page.

Choose Enclosure Options		
<b>12</b>	NEMA 12	\$0
<b>SH</b>	NEMA 12 with space heater	\$945
<b>3R</b>	NEMA 3R with space heater	\$1,890



0 to 1,500 HP			
<b>A</b>	<b>B</b>	<b>C</b>	
Choose core unit	Choose Motor Current (A)**	Choose Exit/Landing Option***	
MVB41	025	T	\$57,398
MVB41	025	B	\$57,111
MVB41	025	C	\$55,998
MVB41	045	T	\$57,398
MVB41	045	B	\$57,111
MVB41	045	C	\$55,998
MVB41	055	T	\$57,398
MVB41	055	B	\$57,111
MVB41	055	C	\$55,998
MVB41	080	T	\$57,398
MVB41	080	B	\$57,111
MVB41	080	C	\$55,998
MVB41	090	T	\$57,398
MVB41	090	B	\$57,111
MVB41	090	C	\$55,998
MVB41	133	T	\$57,398
MVB41	133	B	\$57,111
MVB41	133	C	\$55,998
MVB41	170	T	\$75,126
MVB41	170	B	\$72,884
MVB41	170	C	\$70,177

1,501 to 3,000 HP			
<b>A</b>	<b>B</b>	<b>C</b>	
Choose core unit	Choose Motor Current (A)**	Choose Exit/Landing Option***	
MVB43	025	T	\$68,459
MVB43	025	B	\$66,085
MVB43	025	C	\$63,860
MVB43	045	T	\$68,459
MVB43	045	B	\$66,085
MVB43	045	C	\$63,860
MVB43	055	T	\$68,459
MVB43	055	B	\$66,085
MVB43	055	C	\$63,860
MVB43	080	T	\$68,459
MVB43	080	B	\$66,085
MVB43	080	C	\$63,860
MVB43	090	T	\$68,459
MVB43	090	B	\$66,085
MVB43	090	C	\$63,860
MVB43	133	T	\$68,459
MVB43	133	B	\$66,085
MVB43	133	C	\$63,860
MVB43	170	T	\$75,026
MVB43	170	B	\$72,934
MVB43	170	C	\$70,427
MVB43	225	T	\$75,026
MVB43	225	B	\$72,934
MVB43	225	C	\$70,427
MVB43	330	T	\$75,026
MVB43	330	B	\$72,934
MVB43	330	C	\$70,427
MVB43	360	T	\$75,026
MVB43	360	B	\$72,934
MVB43	360	C	\$70,427

Choose Service Entrance Rated (for stand-alone single units)		
<b>S</b>	Yes	\$1,022
<b>N</b>	No	\$0

Choose Bus Options +		0 to 1,500 HP	1,500 to 3,000 HP
<b>8N</b>	800A Non-insulated bus	\$3,956	\$3,956
<b>8I</b>	800A Insulated bus	\$5,204	\$5,204
<b>1N</b>	1,200A Non-insulated bus	\$4,174	\$4,174
<b>1I</b>	1,200A Insulated bus	\$5,467	\$5,467
<b>2N</b>	2,000A Non-insulated bus	\$5,815	\$5,815
<b>2I</b>	2,000A Insulated bus	\$7,683	\$7,683
<b>NR</b>	None required	\$0	\$0

***Exit / Landing Options	
<b>T</b>	Top exit with landing pad
<b>B</b>	Bottom exit with landing pad
<b>C</b>	Top or bottom exit landing on bypass contactor

+Bus not required for single stand-alone unit.

Bus is required for connection of 2 or more units.

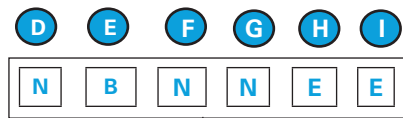
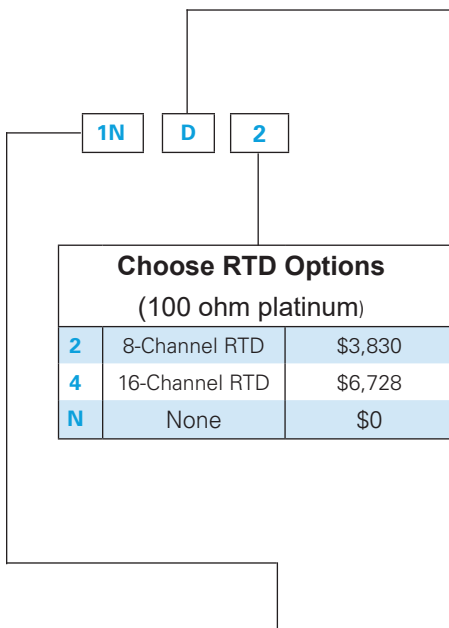
Any unit bus will require additional MLO section. Please contact factory for pricing and delivery.



# Medium Voltage Soft Starter

Choose Option Zero Sequence Ground Fault CT 2000:1 (Residual included)		
<b>G</b>	Yes	\$710
<b>N</b>	No	\$0

Choose Communications Options (RS-485 Modbus RTU standard)		
<b>D</b>	DeviceNet	\$3,108
<b>E</b>	Ethernet	\$3,374
<b>P</b>	Profibus	\$5,686
<b>N</b>	None	\$0



Choose RTD Options (100 ohm platinum)		
<b>2</b>	8-Channel RTD	\$3,830
<b>4</b>	16-Channel RTD	\$6,728
<b>N</b>	None	\$0

Choose Control Options Choose one option for each item below						
<b>D</b>	<b>A</b>	ATL option*	<b>D</b>	<b>N</b>	None	\$2,220
<b>E</b>	<b>B</b>	Green start push button and red stop extended push button*	<b>E</b>	<b>N</b>	None	\$250
<b>F</b>	<b>C</b>	Red run light and green stop light	<b>F</b>	<b>N</b>	None	\$360
<b>G</b>	<b>D</b>	Amber fault light and black reset push button	<b>G</b>	<b>N</b>	None	\$305
<b>H</b>	<b>E</b>	Local-off-remote 3-position switch	<b>H</b>	<b>N</b>	None	\$246
<b>I</b>	<b>F</b>	Emergency stop push button	<b>I</b>	<b>N</b>	None	\$164

Choose Bus Splice Options (must match bus option selected)		
<b>8N</b>	800A non-insulated bus splice	\$360
<b>8I</b>	800A insulated bus splice	\$950
<b>1N</b>	1,200A non-insulated bus splice	\$885
<b>1I</b>	1,200A insulated bus	\$1,008
<b>2N</b>	2,000A non-insulated bus	\$1,724
<b>2I</b>	2,000A insulated bus	\$1,968
<b>NR</b>	None required	\$0

\*ATL option comes with start and stop push buttons (i.e., start stop push buttons cannot be selected).

No selection = keypad control.  
Recommend E-stop option be selected.

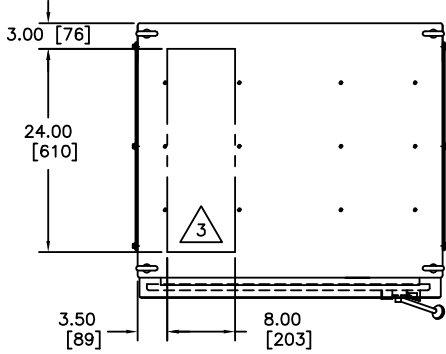
**\* All built to order starters are 4160V only.**

**\*\*Motor currents vs. HP are typical; confirm actual motor current.**

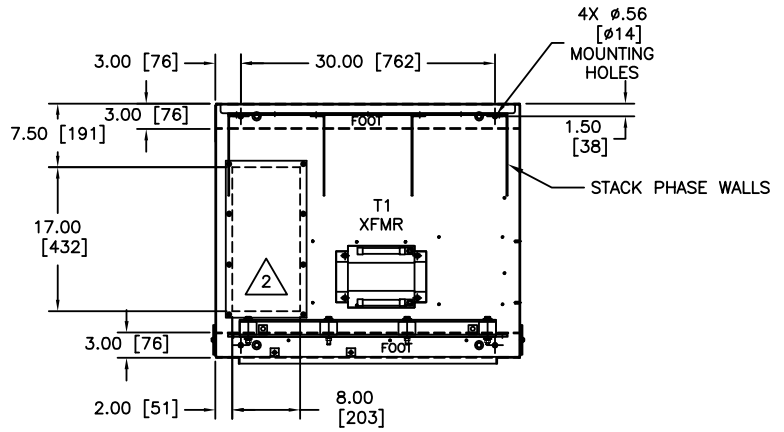
**Service factor not accounted for; adjust if required.**

Example: A 3,000 HP (MVB43), 225 A (225) unit with the following options: bottom exit w/landing pad (B), NEMA 12 enclosure (12), service entrance rated (S), with ground fault (G), 1,200 A non-insulated bus (1N), with start and stop buttons (B), without run and stop lights (N), without fault and reset lights (N), with a local-off-remote switch (E), with emergency stop push button (F), would build the following code string: **MVB43225B12SG1N1ND2NBNNEF**

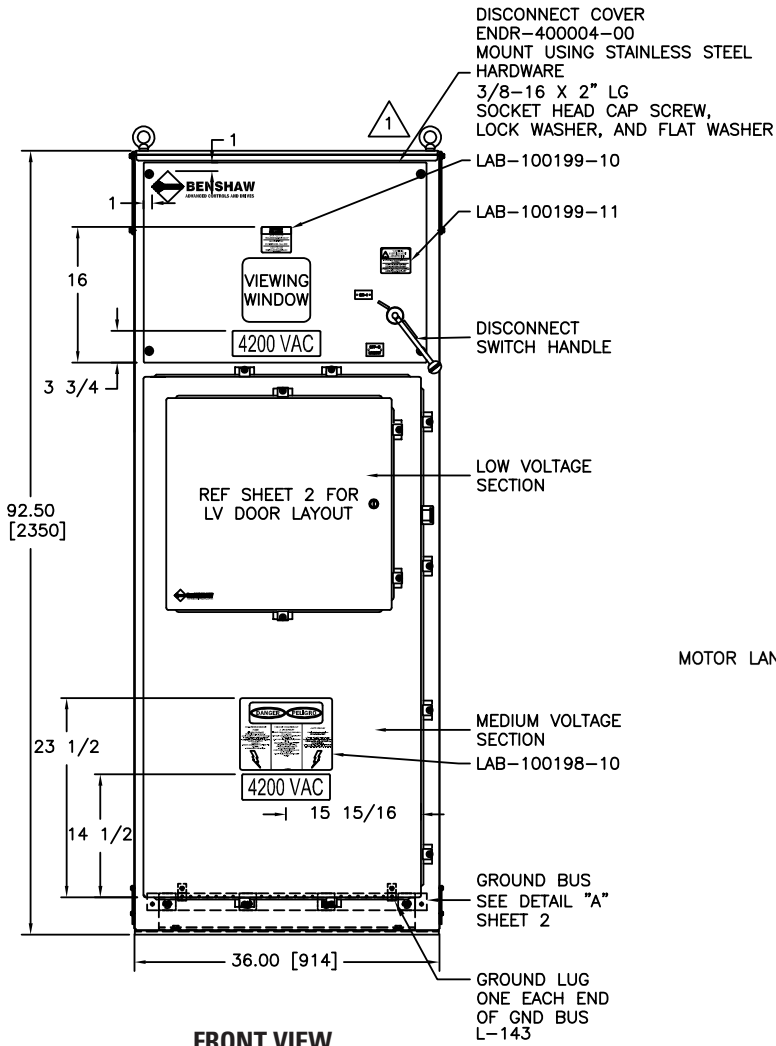
# MVRXE SERIES - DRAWINGS



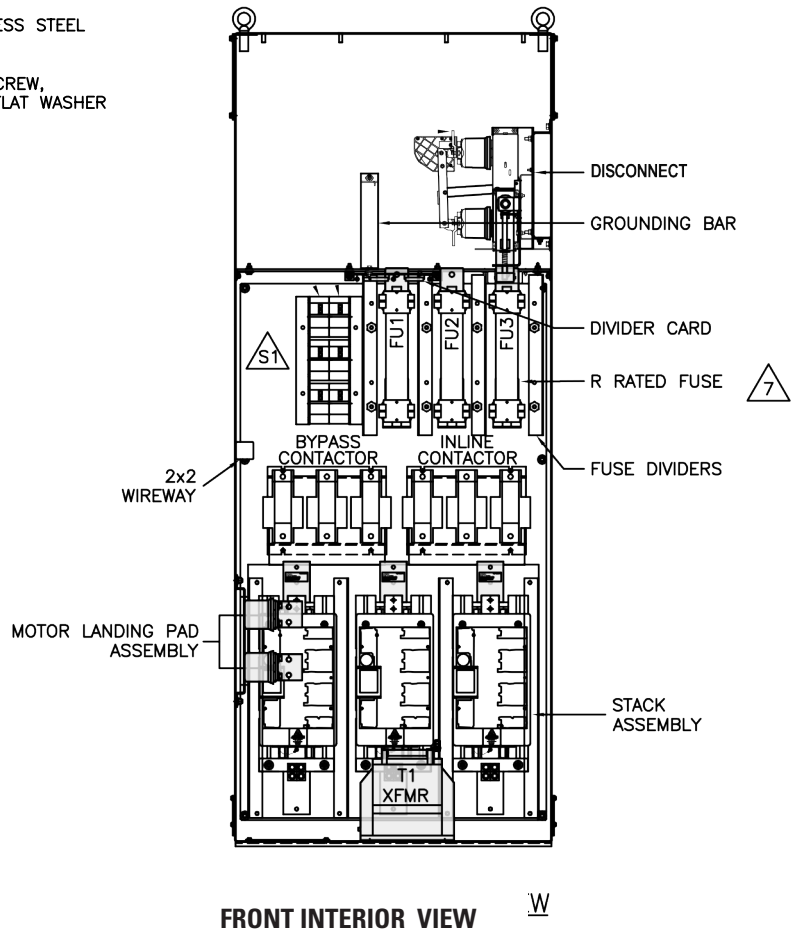
**TOP VIEW**



**FRONT OF ENCLOSURE PLAN VIEW**

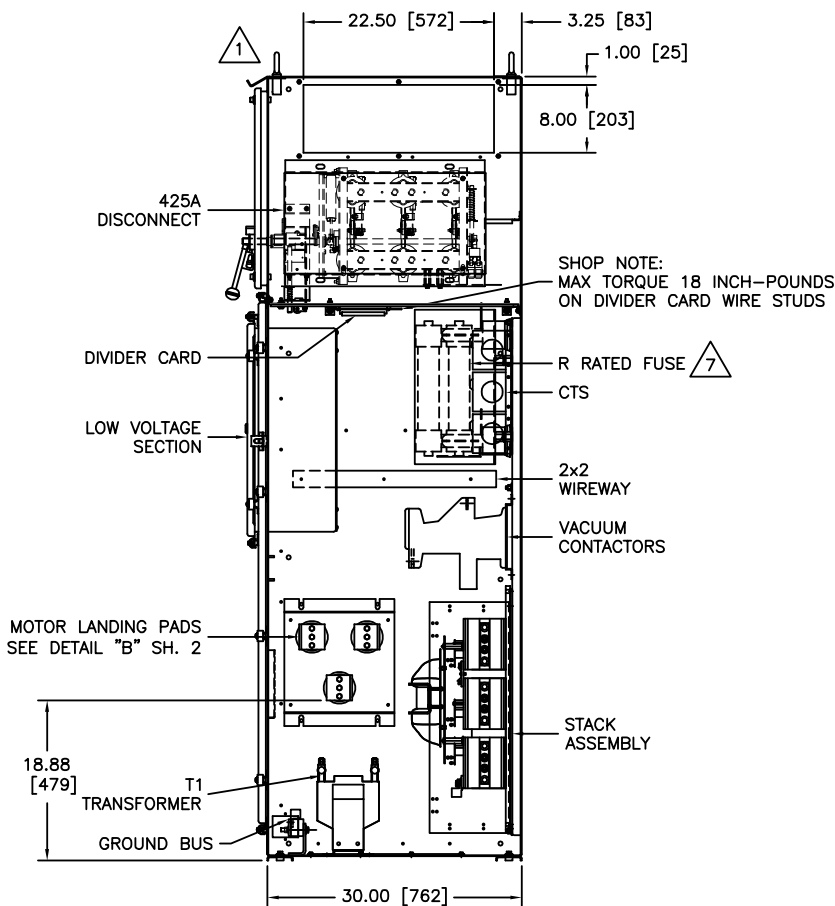
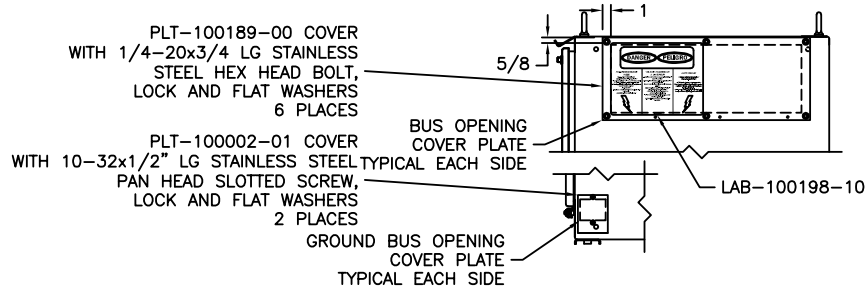


**FRONT VIEW**



**FRONT INTERIOR VIEW**

# MVRXE SERIES - DRAWINGS



Notes:

- $\triangle 1$  Removable lifting eyebolts.
- $\triangle 2$  Cable entry /exit area. Cutout with cover plate supplied.
- $\triangle 3$  Cable entry/exit area. No cutout supplied. Customer to cut as required.
- $\triangle 4$  R-fuses shown for reference. Reference sales order for fuse size.

**RIGHT SIDE INTERIOR VIEW**

## MVRMX SERIES

**SOLID STATE REDUCED VOLTAGE STARTERS - 5KV/7.2 KV15 KV ... TO 25,000HP**

*Only Benschaw has designed, built and supports more than 40,000 solid state starters, from 2,300 volts to 15kV, for applications ranging from pumps, compressors and chillers to fans and blowers, crushers, chippers and conveyors; for every motor type: induction, synchronous, two-speed, reversing and wound rotor.*

*The RediStart CFMVRMX series with MX<sup>3</sup> technology is a fully integrated, programmable family of Class E2 load break/combination solid state starters. This integrated design includes control and power electronics, bypass and isolation contactors that reduce maintenance and operating cost when compare to other methods.*

### KEY ADVANTAGES

- Protect machinery from failure and excessive maintenance caused by mechanical shock during starting or stopping operation.
- The RediStart MVRMX provides smooth, step-less acceleration and controlled deceleration.
- Protect electric systems from disruptive voltage drops and power outages caused by motor locked rotor inrush current.
- The RediStart MVRMX starter precisely controls the current ramp during start up.
- Protect mission-critical motors from failure or unscheduled outages caused by machine or electrical system faults.
- The RediStart MVRMX starter provides complete, high performance, coordinated line monitoring, motor control and protection.



**Guaranteed ... for three full years.**

**Only Benschaw has a three year guarantee.**

Every Benschaw solid state starter is guaranteed for three full years. Other manufacturers limit their warranties to one year. But at Benschaw, we believe that, because we build them better, we can guarantee them longer.



\*3 year warranty requires authorized startup - 1 year warranty without authorized startup.

## MVRMX SERIES

### COMBINATION SOLID STATE STARTERS - 7.2KV/15KV CLASS BENSHAW JUMBO SOLUTION FOR LARGE MOTORS



Only Benschaw has a solution for your largest motor needs, up to 16,000 HP at 6900 V and 25,000 HP at 13800 V. For the largest motor starting applications, Benschaw provides a circuit breaker solution for isolation and protection for the motor. Benschaw's team of engineers will develop a custom solution for the application. Benschaw provides the flexibility of using existing switchgear, or will source new switchgear from any major vendor, which provides a seamless transition for maintenance personnel. Customers must provide single-phase control power for controls in this configuration.

#### OPTIONS

- Start/Stop Pushbutton
- Push-To-Test Contact Assembly
- Hand-Off-Auto Selector Switch
- Two-Three Position Selector Switch
- Single-Phase Analog Ammeter w/CT
- Meters
- Communications Devices (Profibus, Ethernet, DeviceNet)
- RTD Module
- Ground Fault
- Overload Relays
- Live Line Indicators

# MVRMX SERIES - PRICING

## STANDARD DUTY

### 2300 V

Model Number	Standard Duty			Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
	Volts	HP	FLA	H	W	D			
CFMVRMX12-150-2300**	2300	150	36	92.5	36	30	430	\$64,769	\$66,905
CFMVRMX12-500-2300**	2300	500	120	92.5	36	30	430	\$64,776	\$66,972
CFMVRMX12-750-2300**	2300	750	180	92.5	36	30	430	\$64,776	\$66,972
CFMVRMX12-1000-2300**	2300	1000	240	92.5	36	30	430	\$68,890	\$71,093
CFMVRMX12-1250-2300**	2300	1250	300	92.5	36	30	430	\$68,890	\$71,093
CFMVRMX12-1500-2300**	2300	1500	360	92.5	36	30	430	\$68,890	\$71,093
CFMVRMX12-2000-2300**(1)	2300	2000	453	92.5	96	36	430	\$154,961	\$157,164
CFMVRMX12-2500-2300**(1)	2300	2500	566	92.5	96	36	430	\$184,826	\$187,029
CFMVRMX12-3000-2300**(1)	2300	3000	679	94	159	50	430	\$509,622	CF

Standard duty = 350% current for 30 seconds.

(1) Units not configured with bus through all enclosure sections.

\*\* Insert appropriate option code as shown below:

NEMA 1 = 1

NEMA 12 = 12

NEMA 3R = 3R

CF - Consult Factory

### 3300 V

Model Number	Standard Duty			Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
	Volts	HP	FLA	H	W	D			
CFMVRMX12-300-3300-**	3300	300	51	92.5	36	30	430	\$64,769	\$66,905
CFMVRMX12-750-3300-**	3300	750	127	92.5	36	30	430	\$64,776	\$66,972
CFMVRMX12-1000-3300-**	3300	1000	169	92.5	36	30	430	\$64,776	\$66,972
CFMVRMX12-1250-3300-**	3300	1250	211	92.5	36	30	430	\$68,890	\$71,093
CFMVRMX12-1500-3300-**	3300	1500	254	92.5	36	30	430	\$68,890	\$71,093
CFMVRMX12-2000-3300-**	3300	2000	338	92.5	36	30	430	\$68,890	\$71,093
CFMVRMX18-2500-3300-**(1)	3300	2500	395	92.5	96	36	2800	\$154,961	\$157,164
CFMVRMX18-3000-3300-**(1)	3300	3000	473	92.5	96	36	2800	\$154,961	\$157,164
CFMVRMX18-3500-3300-**(1)	3300	3500	552	92.5	96	36	2800	\$184,826	\$187,029
CFMVRMX18-4000-3300-**(1)	3300	4000	631	94	159	50	2800	\$509,622	CF
CFMVRMX18-4500-3300-**(1)	3300	4500	710	94	159	50	2800	\$509,622	CF

Standard duty = 350% current for 30 seconds.

(1) Units not configured with bus through all enclosure sections.

\*\* Insert appropriate option code as shown below:

NEMA 1 = 1

NEMA 12 = 12

NEMA 3R = 3R

CF - Consult Factory

# MVRMX SERIES - PRICING

## STANDARD DUTY

### 4160 V

Model Number	Standard Duty			Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
	Volts	HP	FLA	H	W	D			
CFMVRMX18-300-4160**	4160	300	40	92.5	36	30	2800	\$68,129.00	\$70,331
CFMVRMX18-750-4160**	4160	750	99	92.5	36	30	2800	\$68,129.00	\$70,331
CFMVRMX18-1000-4160**	4160	1000	133	92.5	36	30	2800	\$68,129.00	\$70,331
CFMVRMX18-1250-4160**	4160	1250	166	92.5	36	30	2800	\$68,169.00	\$70,371
CFMVRMX18-1500-4160**	4160	1500	200	92.5	36	30	2800	\$75,190.00	\$77,393
CFMVRMX18-2000-4160**	4160	2000	266	92.5	36	30	2800	\$75,190.00	\$77,393
CFMVRMX18-2500-4160**	4160	2500	333	92.5	36	30	2800	\$75,190.00	\$77,393
CFMVRMX18-3000-4160**	4160	3000	360	92.5	36	30	2800	\$75,190.00	\$77,393
CFMVRMX18-3500-4160**(1)	4160	3500	466	92.5	96	36	2800	\$154,961.00	\$157,164
CFMVRMX18-4000-4160**(1)	4160	4000	532	92.5	96	36	2800	\$154,966.00	\$157,164
CFMVRMX18-4500-4160**(1)	4160	4500	600	92.5	96	36	2800	\$184,826.00	\$187,029
CFMVRMX18-5000-4160**(1)	4160	5000	626	94	159	50	2800	\$509,622.00	CF
CFMVRMX18-5500-4160**(1)	4160	5500	688	94	159	50	2800	\$509,622.00	CF

Standard duty = 350% current for 30 seconds.

(1) Units not configured with bus through all enclosure sections.

\*\* Insert appropriate option code as shown below:

NEMA 1 = 1

NEMA 12 = 12

NEMA 3R = 3R

CF - Consult Factory

# MVRMX SERIES - PRICING

## HEAVY DUTY

### 2300 V

Model Number	Heavy Duty			Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
	Volts	HP	FLA	H	W	D			
CFMVRMX12-150-2300-**	2300	150	36	92.5	36	30	430	\$64,769	\$66,905
CFMVRMX12-500-2300-**	2300	500	120	92.5	36	30	430	\$64,776	\$66,905
CFMVRMX12-750-2300-**	2300	750	180	92.5	36	30	430	\$68,890	\$71,093
CFMVRMX12-1000-2300-**	2300	1000	240	92.5	36	30	430	\$68,890	\$71,093
CFMVRMX18-1500-2300-**(1)	2300	1500	360	92.5	96	36	2800	\$154,961	\$157,164
CFMVRMX18-2000-2300-**(1)	2300	2000	453	92.5	96	36	2800	\$154,961	\$157,164
CFMVRMX18-2250-2300-**(1)	2300	2250	509	94	159	50	2800	\$509,622	CF

Heavy duty = 500% current for 30 seconds.

(1) Units not configured with bus through all enclosure sections.

\*\* Insert appropriate option code as shown below:

NEMA 1 = 1

NEMA 12 = 12

NEMA 3R = 3R

CF - Consult Factory

### 3300 V

Model Number	Heavy Duty			Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
	Volts	HP	FLA	H	W	D			
CFMVRMX12-300-3300-**	3300	300	51	92.5	36	30	430	\$64,769	\$66,905
CFMVRMX12-750-3300-**	3300	750	127	92.5	36	30	430	\$64,776	\$66,905
CFMVRMX12-1000-3300-**	3300	1000	169	92.5	36	30	430	\$68,890	\$71,093
CFMVRMX12-1250-3300-**	3300	1250	211	92.5	36	30	430	\$68,890	\$71,093
CFMVRMX12-1500-3300-**	3300	1500	254	92.5	36	30	430	\$68,890	\$71,093
CFMVRMX18-2000-3300-**(1)	3300	2000	338	92.5	96	36	2800	\$154,961	\$157,164
CFMVRMX18-2500-3300-**(1)	3300	2500	295	92.5	96	36	2800	\$154,961	\$157,164
CFMVRMX18-3000-3300-**(1)	3300	3000	473	92.5	96	36	2800	\$154,961	\$157,164
CFMVRMX18-3500-3300-**(1)	3300	3500	552	94	159	50	2800	\$509,622	CF
CFMVRMX18-4000-3300-**(1)	3300	4000	631	94	159	50	2800	\$509,622	CF
CFMVRMX18-4500-3300-**(1)	3300	4500	710	94	159	50	2800	\$509,622	CF

Heavy duty = 500% current for 30 seconds.

(1) Units not configured with bus through all enclosure sections.

\*\* Insert appropriate option code as shown below:

NEMA 1 = 1

NEMA 12 = 12

NEMA 3R = 3R

CF - Consult Factory



# MVRMX SERIES - PRICING

## HEAVY DUTY

### 4160 V

Model Number	Heavy Duty			Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
	Volts	HP	FLA	H	W	D			
CFMVRMX18-300-4160-**	4160	300	40	92.5	36	30	2800	\$68,129.00	\$70,331
CFMVRMX18-750-4160-**	4160	750	99	92.5	36	30	2800	\$68,129.00	\$70,331
CFMVRMX18-1000-4160-**	4160	1000	133	92.5	36	30	2800	\$68,129.00	\$70,331
CFMVRMX18-1250-4160-**	4160	1250	166	92.5	36	30	2800	\$75,190.00	\$77,393
CFMVRMX18-1500-4160-**	4160	1500	200	92.5	36	30	2800	\$75,190.00	\$77,393
CFMVRMX18-2000-4160-**	4160	2000	266	92.5	36	30	2800	\$75,190.00	\$77,393
CFMVRMX18-2500-4160-**(1)	4160	2500	333	92.5	96	36	2800	\$154,961.00	\$157,164
CFMVRMX18-3000-4160-**(1)	4160	3000	360	92.5	96	36	2800	\$154,961.00	\$157,164
CFMVRMX18-3500-4160-**(1)	4160	3500	466	92.5	96	36	2800	\$154,961.00	\$157,164
CFMVRMX18-4000-4160-**(1)	4160	4000	532	94	159	50	2800	\$509,622.00	CF

Heavy duty = 500% current for 30 seconds.

(1) Units not configured with bus through all enclosure sections.

\*\* Insert appropriate option code as shown below:

NEMA 1 = 1

NEMA 12 = 12

NEMA 3R = 3R

CF - Consult Factory

## **MV2H SERIES**

### **TWO-HIGH SOFT STARTER**

*Benshaw MV2H Two-High Solid State Starters provide separate medium and low voltage sections for each starter. Both sections include a complete starter - load break disconnect switch, Class R rated fuses, inline and bypass contactors and power stacks, to allow complete independent control of two motors.*

*Each starter has its own MX<sup>3</sup> control board and keypad — to allow separate protection and starting parameters — and is fully customizable, with options such as grounding balls and infrared viewing windows available. This design allows for an integral power bus for use in medium voltage lineups and motor control centers.*

*MV2H Two-High Solid State Starters are UL labelled up to 195A (per motor) through 4160V with NEMA 1 enclosure.*



### **KEY ADVANTAGES**

- Two 350% - 30 seconds rated solid state starters
- Compact footprint - use for standalone, back-to-back and MCC/lineup applications
- Dual redundant configuration (switch-selectable emergency backup full voltage starters)
- Rugged, welded enclosure with chain drive flange handle mechanism
- Benshaw's advanced, digital MX<sup>3</sup> control and protection
- 50 KAIC (2600 or 4800 VAC) short circuit fault rated
- 45kV BIL
- Built-in self test features
- NEMA 1, UL 347 listed



# MV2H SERIES - TECHNICAL DATA

Feature	Specification/Rating
Disconnect Switches	400A fixed mount
Fuses	Class R - sized as per motor FLA
Inline Contactor	400A fixed mount
Bypass Contactor	400A fixed mount
SCR Power Stack	350% for 30 seconds; 2 starts per hour
No. SCRs per phase	4/phase; 12 total
CT Ratio	5A secondary - sized as per motor FLA
Control Power Transformer	Included, 120V secondary
PIV Rating	12KV
BIL Rating	45KV
Short Circuit Rating	50KAIC
Controller Class	E2
Bypass Type	Running duty
Communication Protocol	ModbusRS-485
Amp Rating	Max 195A for each starter
Voltage Rating	Up to 4160V
Enclosure	NEMA 1
Dimensions	92.5" H x 45" W X 36" D
Operating Temperature	0 to 40°C (14 to 104°F) without derating
Storage Temperature	-20 to 70°C (-4 to 155°F)
Altitude	Up to 1000m(3300 ft) above sea level without derating
Certification	UL 347

## PRICING

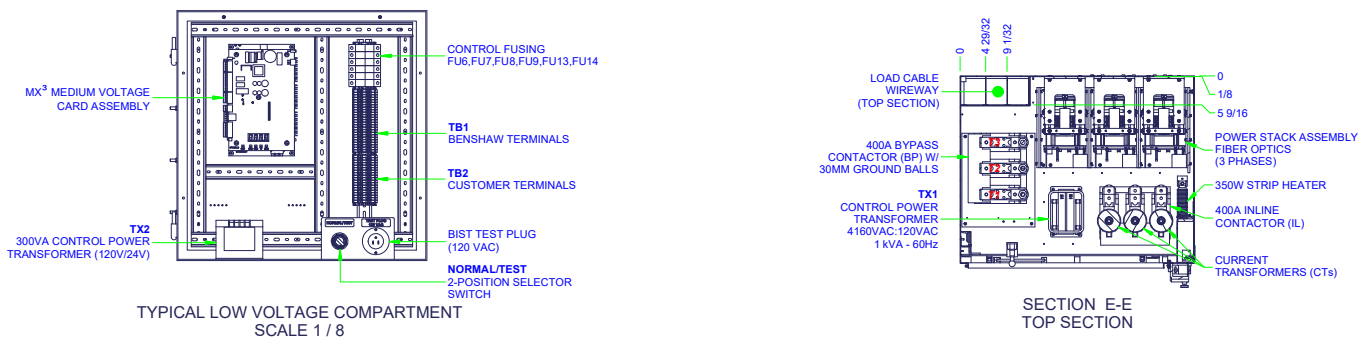
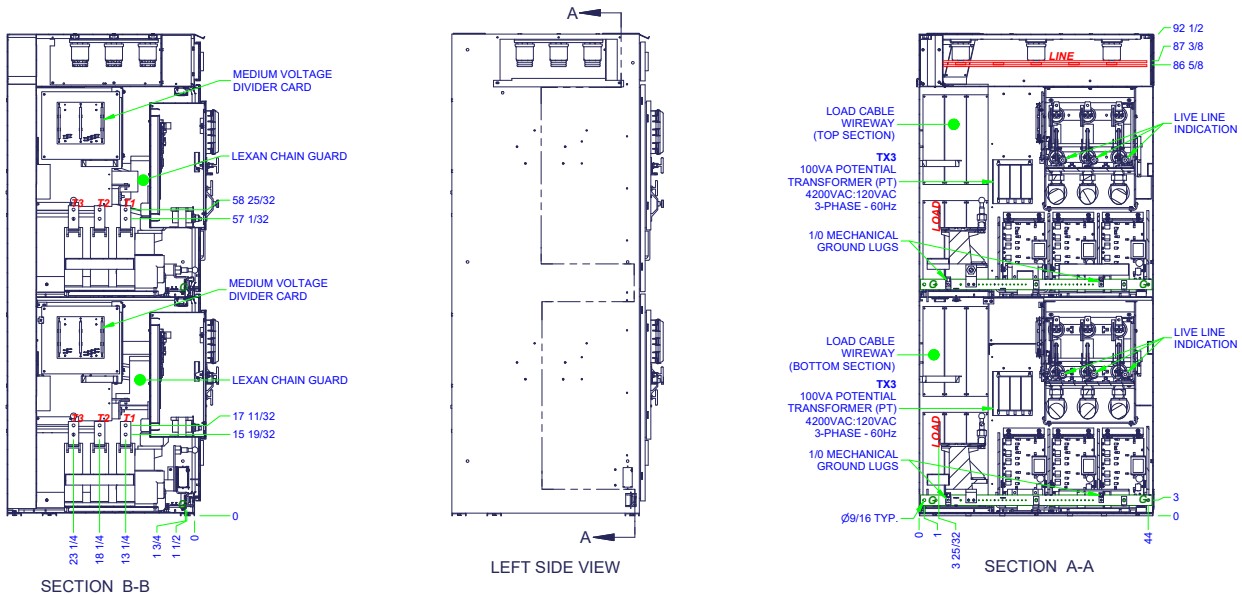
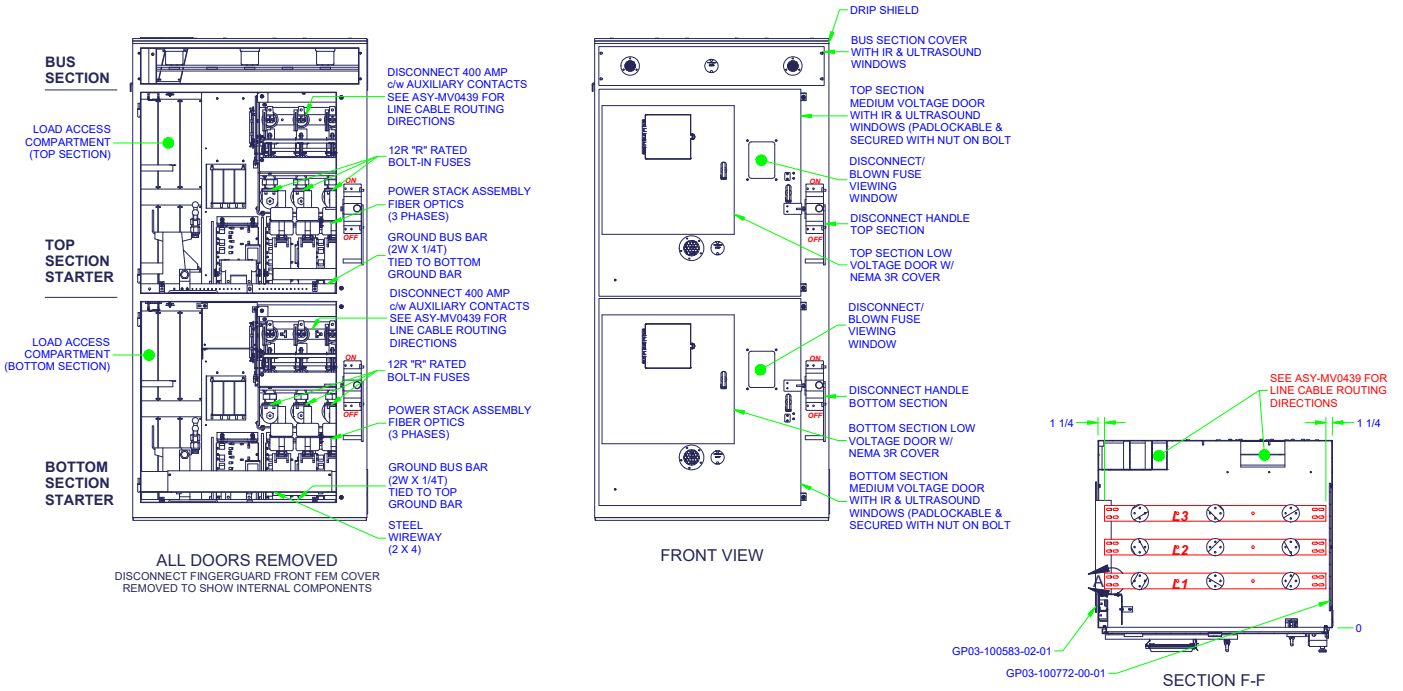
### 2-HIGH RVSS

Model Number	Volt	HP*	FLA*	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12	NEMA 3R
				H	W	D		List Price	List Price
MV2H-TB-500-500-2300-**	2300	500	120	92.5	45	36	1900	\$105,403	CF
MV2H-TB-750-750-3300-**	3300	750	127	92.5	45	36	1900	\$105,403	CF
MV2H-TB-1000-1000-4160-**	4160	1000	133	92.5	45	36	1900	\$105,403	CF

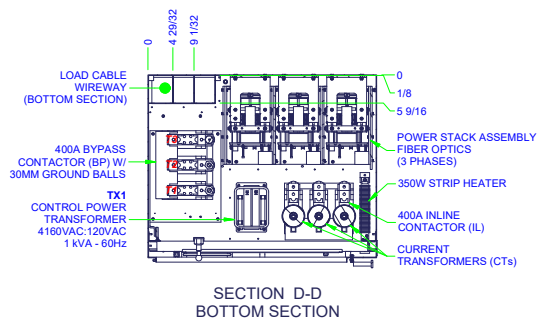
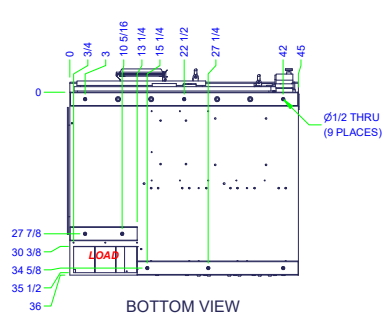
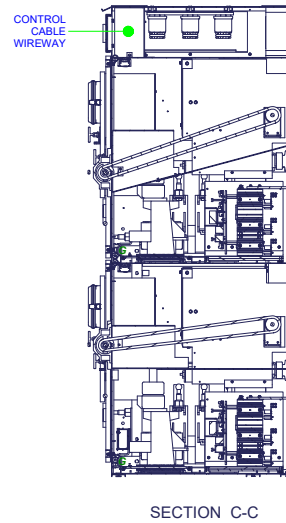
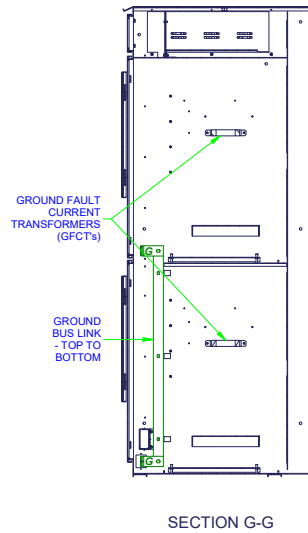
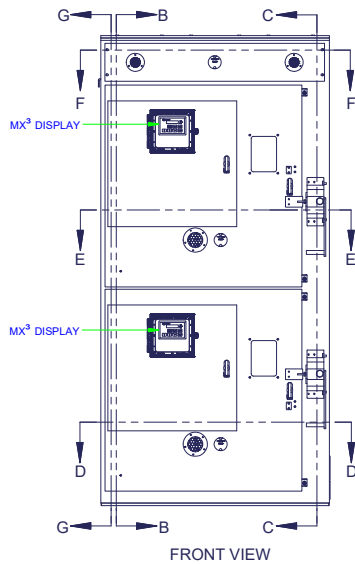
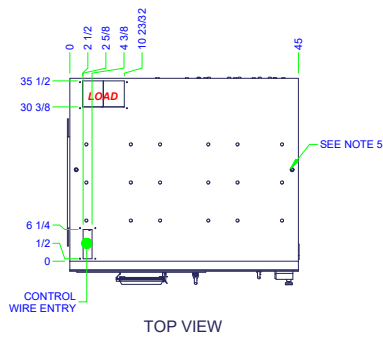
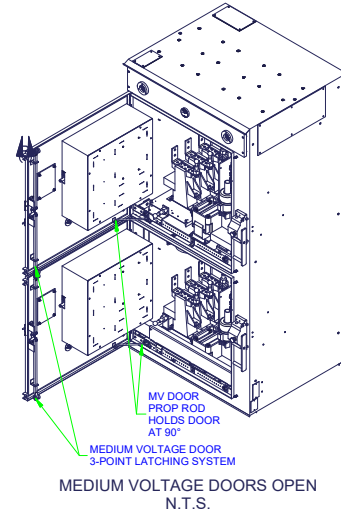
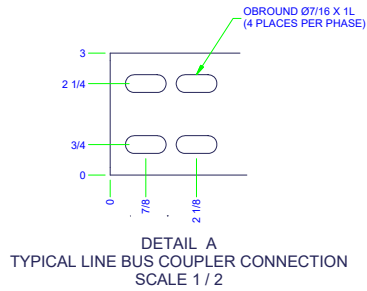
\*HP and FLA rating is per motor. All ratings noted are the max available for 2-high configurations.

CF - Consult Factory

# MV2H SERIES - DRAWINGS



# MV2H SERIES - DRAWINGS



# MEDIUM VOLTAGE SOFT STARTER REQUEST FORM

Please supply ALL the following information, so we can accurately select a starter for your application.

Type of application (pump, compressor, conveyor, etc.)

Motor rated power (KW or HP)	_____	Motor Full Load Current (FLA)	_____
Motor nominal voltage (V)	_____	Motor synchronous speed (RPM)	_____
Motor current vs. speed curve or Ist/In (% or Per Unit)	_____	Motor speed/torque curve or Tmax/Tn (% or Per Unit)	_____
	_____	Load speed/torque curve	_____
Rotor inertia $J=GD^2/4$ (kgm)		(% or per unit)	
Load inertia $J=GD^2/4$ (kgm) at motor speed	_____		
Starts per hour	_____		
Cabinet degree of protection (1PXX/NEMA)	_____	Time between starts	_____
Ambient temperature (operating & storage) requirement	_____		
		Altitude (meters or feet above sea level)	_____
Power cables entry (top or bottom)			
Soft starter only (IEC style) or standard unit with load break switch and power fuses/ VCB	_____	# Of units (single, multiple in line up) If line-up of multiple units, how many per line-up (required for sizing horizontal/overhead bus).	_____
Max. Shipping split dimensions (WxHxD)			
Additional notes / requirements:	_____		

If your application involves a synchronous motor (soft starter with synchronous exciter), please also indicate:

Type of exciter (rotating or static)	_____	New or refurbished motor?	_____
Full nameplate data of motor and exciter	_____	Data for existing / old excitation system	_____
For rotating exciter: DC voltage, DC current of the exciter generator field	_____	For static exciter: DC voltage, DC current of motor field	_____
		For static exciter: full data of field starting / discharge resistor	_____
If retrofit application, will the existing static exciter field starting /discharge resistor be used? If not, is this within soft starter manufacturer's scope of supply?	_____	Availability of LV 3 phase supply KVA required: 250V x IDC x 3 phase x 1.3.	
Additional notes / requirements:		Advise voltage and frequency.	_____

**SECTION 2**

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## **FULL VOLTAGE ACROSS-THE-LINE STARTERS**

### **BASIC ATL STARTER**

*Benshaw Basic Medium Voltage Across-The-Line (ATL) Starters are full voltage controllers for three phase induction motors. All ATL starters from Benshaw are supplied in a free-standing enclosure, with NEMA 12 and NEMA 3R configurations available to suit your application requirements.*

*Benshaw's compact, flexible, full voltage starters can be customized to support reversing, multiple motor, combination and non-combination, induction, synchronous, wound rotor, mining duty (skid mounted), and other motor control requirements.*

### **KEY FEATURES**

The basic medium voltage combination ATL starter includes:

- NEMA 12 or 3R enclosure
- Cable entry top
- Cable exit bottom
- Disconnect Switch
  - Load break/fault make
  - 5kV Class "R" rated fuses
  - Current limiting
  - Grounding bar
  - Viewing window
- Withstand rating: 50kA
- 60kV BIL rating
- Vacuum motor starting contactor
- Start/stop push buttons
- Electronic Overload protection
  - Class 10-30 adjustable
  - 1 NO, 1 NC trip contact
  - "Trip-Free" design
  - Phase imbalance protection
  - Phase reversal protection
  - Phase loss protection
  - Test function/trip indication
  - Fault indication



Basic ATL Starter



# FULL VOLTAGE ACROSS-THE-LINE STARTERS - PRICING

## BASIC ATL STARTER

### 2300V

Model Number	HP	FLA	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
CFMVATL-150-2300**	150	36	92.5	24	30	1200	\$41,124	\$43,556
CFMVATL-500-2300**	500	120	92.5	24	30	1200	\$42,987	\$44,240
CFMVATL-750-2300**	750	180	92.5	24	30	1200	\$45,070	\$45,356
CFMVATL-1000-2300**	1000	240	92.5	24	30	1200	\$45,137	\$45,420
CFMVATL-1250-2300**	1250	300	92.5	24	30	1200	\$45,567	\$46,329
CFMVATL-1500-2300**	1500	360	92.5	24	30	1200	\$45,997	\$46,783

\*\* Insert appropriate option code as shown below:

NEMA 12 = 12

NEMA 3R = 3R

### 4160V

Model Number	HP	FLA	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
CFMVATL-300-4160**	300	40	92.5	24	30	1300	\$40,254	\$42,686
CFMVATL-750-4160**	750	99	92.5	24	30	1300	\$42,074	\$45,477
CFMVATL-1000-4160**	1000	133	92.5	24	30	1300	\$42,675	\$45,690
CFMVATL-1250-4160**	1250	166	92.5	24	30	1300	\$42,852	\$45,879
CFMVATL-1500-4160**	1500	200	92.5	24	30	1300	\$44,157	\$46,266
CFMVATL-2000-4160**	2000	266	92.5	24	30	1300	\$44,577	\$46,332
CFMVATL-2500-4160**	2500	333	92.5	24	30	1300	\$44,787	\$46,555
CFMVATL-3000-4160**	3000	360	92.5	36	30	1500	\$44,973	\$46,622

\*\* Insert appropriate option code as shown below:

NEMA 12 = 12

NEMA 3R = 3R

## **FULL VOLTAGE ACROSS-THE-LINE STARTERS**

### **'SMART' ATL STARTER**

*Benshaw 'Smart' Medium Voltage Across-The-Line (ATL) Starters are full voltage controllers for three- phase induction motors. 'Smart' starters include the Benshaw's MX<sup>3</sup> controller for advanced motor protection, metering, diagnostics and communication.*

*Combination 'Smart' starters are supplied in a free-standing enclosure. Enclosures are available in NEMA 12 and NEMA 3R configurations. Enclosures consists of two different compartments. The medium voltage section is located in the main body of the enclosure and the low voltage section containing the control logic is located behind the door in an isolated compartment. Door mounted keypad is included.*

*Standard combination 'Smart' starters are supplied with a load break/fault make disconnect isolation switch, Class "R" motor current limiting fuses, vacuum motor starting contactor and the 'SPE' SureProtex electronic overload protection.*

### **KEY FEATURES**

The 'Smart' medium voltage combination ATL starter includes:

- NEMA 12 or 3R enclosure
- Cable entry top
- Cable exit bottom
- Disconnect Switch
  - Load break/fault make
  - 5kV Class "R" rated fuses
  - Current limiting
  - Grounding bar
  - Viewing window
- Withstand Rating: 50kA
- 60kV BIL rating
- Vacuum motor starting contactor
- 'Smart' programmable keypad with MX<sup>3</sup> controller\*
- Start/stop push buttons (Via Keypad)
- Featured items via MX<sup>3</sup> Keypad
  - MX<sup>3</sup> Overload protection
  - Phase imbalance protection
  - Phase reversal protection
  - Phase loss protection
  - Test function/trip indication
  - Fault indication



'Smart' ATL Starter

## MX<sup>3</sup> CONTROL FEATURES

The “Smart” Medium Voltage “ATL” package includes the addition of the RediStart MX<sup>3</sup> control package for additional branch circuit monitoring motor protection, metering, diagnostics and communication. Refer to MVRMX RediStart MX<sup>3</sup> specification for complete details. A sampling of the enhanced features includes:

### PROTECTION (ANSI STANDARD NUMBERS GIVEN)

- 51 — Electronic motor overload, Class 1 to 40
- 86 — Overload lockout
- 48 — Adjustable up-to-speed timer (off; 0 to 300 seconds)
- 59/27 — Adjustable over/under voltage protection
- 46 — Adjustable line to average current imbalance
- 81 — Adjustable high and low frequency protection
- Single-phase protection
- 66 — Adjustable starts per hour (off or 1 to 20 starts)
- Adjustable time between starts (off or 1 to 600 minutes)
- Backspin timer (off or 1 to 200 minutes)
- 51 — Overcurrent detection (off or 50 to 800%) and time (0.1 to 90.0 sec. in 0.1 sec. intervals)
- 37 — Undercurrent detection (off or 10 to 100% and time (0.1 to 90.0 sec. in 0.1 sec. intervals)
- 51G — Ground fault detection (off or 1 to 100 amps) and time (0.1 to 90.0 sec. in 0.1 sec. intervals)
- Overcurrent, undercurrent and ground fault can each be set to trip or activate a relay
- 50 — Instantaneous electronic overcurrent trip
- 47 — Phase rotation selectable ABC, CBA or Ins (insensitive)
- 38/49 — Remote mountable RTD protection package, 8 or 16 RTD inputs (optional)

### CONTROL

- Local start/stop controls
- Emergency reset capability

### INPUT/OUTPUT AND DISPLAY

- Plain English operation via back-lit LCD display interface
- LCD and LED status and diagnostics (full fault annunciation)
- Programmable metering (amps, volts, frequency, overload, power factor, elapsed time, watts, VARs, watt hours, VA, current imbalance, ground fault current, RTD temperatures with optional RTD module)
- Programmable relay outputs
- Latched fault relay output
- Real-time clock
- Time stamped event recorder
- Password protection
- Battery backed-up starter parameters and lockout times



## FULL VOLTAGE ACROSS-THE-LINE STARTERS - PRICING

### 'SMART' ATL STARTER

#### 2300V

Model Number	HP	FLA	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
CFMVRMXATL-150-2300**	150	36	92.5	24	30	1200	\$43,877	\$44,086
CFMVRMXATL-500-2300**	500	120	92.5	24	30	1200	\$45,878	\$46,098
CFMVRMXATL-750-2300**	750	180	92.5	24	30	1200	\$47,961	\$48,181
CFMVRMXATL-1000-2300**	1000	240	92.5	24	30	1200	\$48,028	\$48,248
CFMVRMXATL-1250-2300**	1250	300	92.5	24	30	1200	\$48,257	\$48,478
CFMVRMXATL-1500-2300**	1500	360	92.5	24	30	1200	\$48,486	\$48,707

\*\* Insert appropriate option code as shown below:  
 NEMA 12 = 12  
 NEMA 3R = 3R

#### 4160V

Model Number	HP	FLA	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
CFMVRMXATL-300-4160**	300	40	92.5	24	30	1300	\$43,007	\$43,007
CFMVRMXATL-750-4160**	750	99	92.5	24	30	1300	\$44,964	\$44,964
CFMVRMXATL-1000-4160**	1000	133	92.5	24	30	1300	\$45,821	\$45,821
CFMVRMXATL-1250-4160**	1250	166	92.5	24	30	1300	\$46,011	\$46,011
CFMVRMXATL-1500-4160**	1500	200	92.5	24	30	1300	\$47,048	\$47,048
CFMVRMXATL-2000-4160**	2000	266	92.5	24	30	1300	\$47,115	\$47,115
CFMVRMXATL-2500-4160**	2500	333	92.5	24	30	1300	\$47,339	\$47,339
CFMVRMXATL-3000-4160**	3000	360	92.5	36	30	1500	\$47,864	\$47,864

\*\* Insert appropriate option code as shown below:  
 NEMA 12 = 12  
 NEMA 3R = 3R

## NOTES

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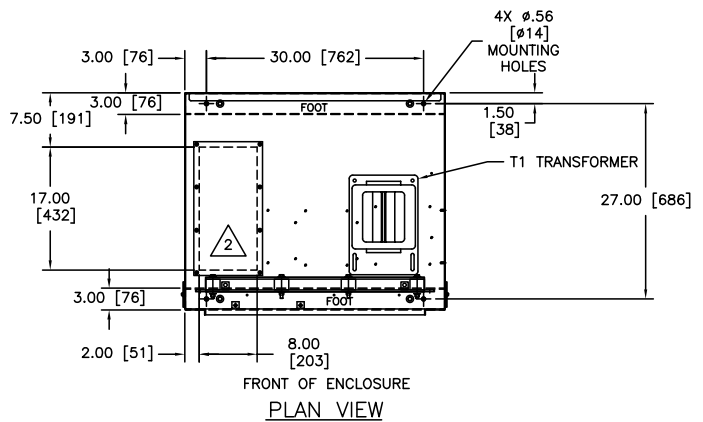
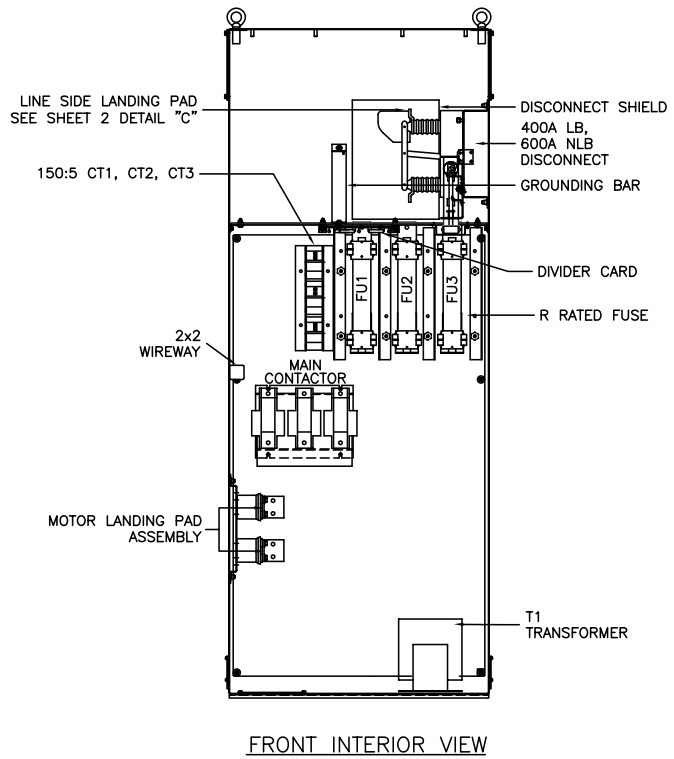
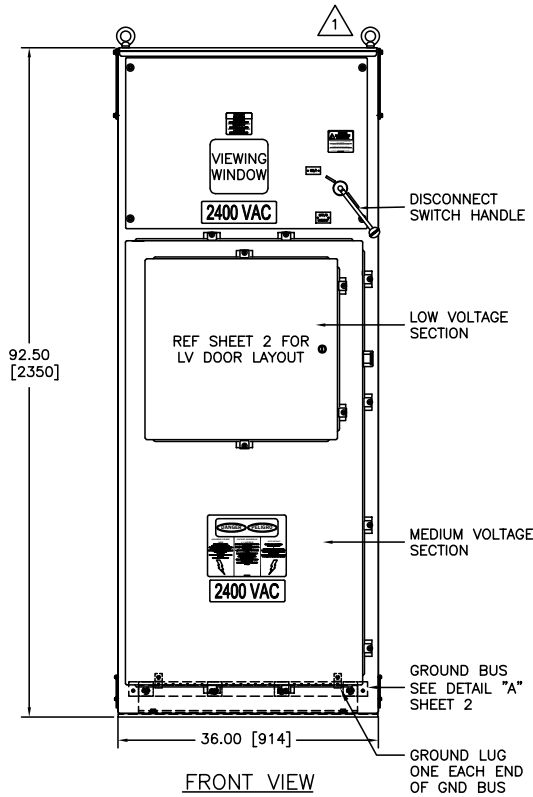
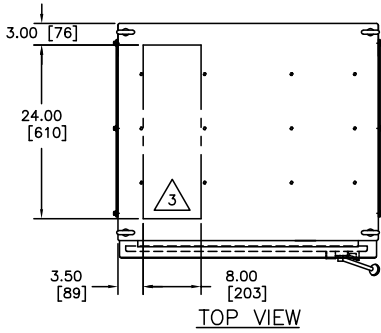
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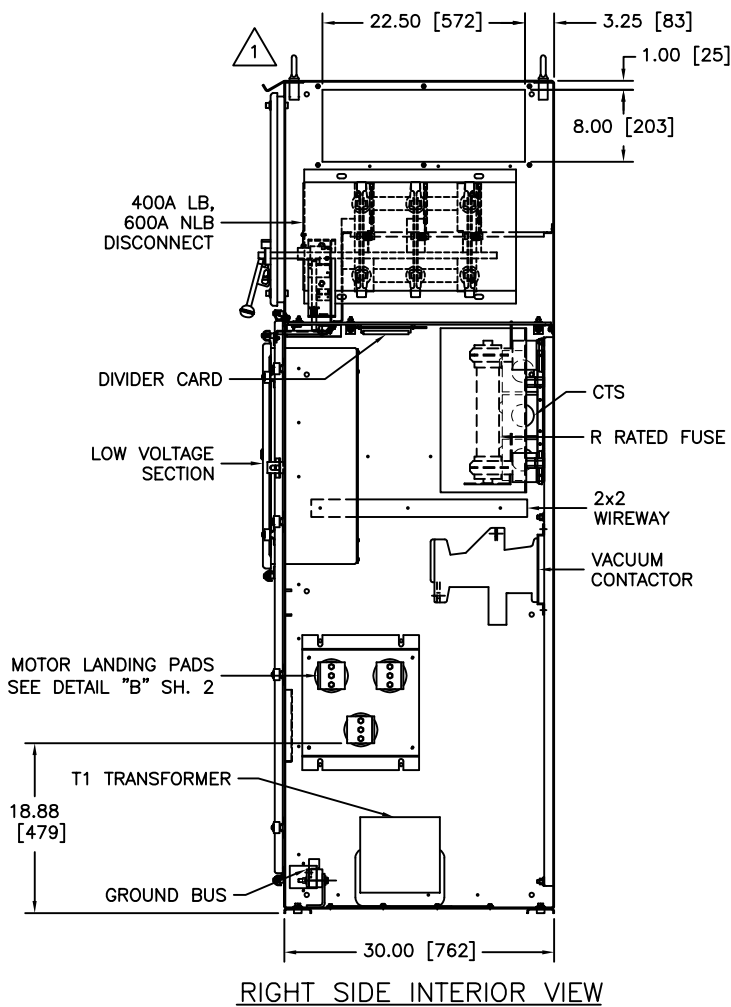
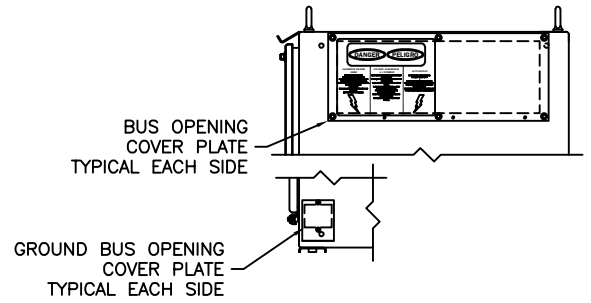
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# FULL VOLTAGE ACROSS-THE-LINE STARTERS - DRAWINGS

## 'SMART' ATL STARTER





**NOTES:**

- 1 REMOVABLE LIFTING EYEBOLTS
- 2 CABLE ENTRY/EXIT AREA. CUTOUT W/ COVER PLATE SUPPLIED
- 3 CABLE ENTRY/EXIT AREA. NO CUTOUT SUPPLIED. CUSTOMER TO CUT AS REQUIRED.
- 4. ENCLOSURE COLOR: ANSI 61 GREY
- 5. TIGHTEN BOLTS PER CHART BELOW

STEEL BOLT TORQUE IN POUND-FOOT [NEWTON-METER]				
1/4-20	5/16-18	3/8-16	1/2-13	5/8-11
5 [6.8]	12 [16.3]	20 [27]	50 [67.8]	95 [128.8]

- 6. APPROXIMATE WEIGHT IS 1200LBS

## FULL VOLTAGE ATL STARTERS SERIES

### COMPACT, BASIC 20" WIDE ATL STARTER

*Benshaw Basic 20" Wide Medium Voltage Across-The-Line (ATL) Starters are full voltage motor controllers designed for those installations where space limitations call for a smaller enclosure footprint.*

#### KEY FEATURES

The 20" wide medium voltage combination ATL starter includes:

- NEMA 12 or 3R enclosure
- Cable entry top
- Cable exit bottom
- 600A Load Break Disconnect Switch
  - 5kV Class "R" rated fuses
  - Current limiting
  - Grounding bar
  - Viewing window
- Withstand Rating: 50kA
- 60kV BIL rating
- Vacuum motor starting contactor
- Start/stop push buttons
- Power fuses sized according to motor or load
- Isolated 120V control section
- "SPE" overload protection
  - Class 10-30 adjustable
  - 1 NO, 1 NC trip contact
  - "Trip-Free" design
  - Phase imbalance protection
  - Phase reversal protection
  - Phase loss protection
  - Test function/trip indication
  - Fault indication
- Optional extendable horizontal bus (800A, 1200A, 1600A or 2000A ratings available)



20" Wide ATL Starter





# FULL VOLTAGE ATL STARTERS SERIES - PRICING

## 20" WIDE BASIC ATL STARTER

### 2300V

Model Number	HP	FLA	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
CFMVATL20-500-2300**	500	120	92.5	20	30	1200	\$73,348	\$75,548
CFMVATL20-750-2300**	750	180	92.5	20	30	1200	\$77,015	\$79,325
CFMVATL20-1000-2300**	1000	240	92.5	20	30	1200	\$80,682	\$83,103
CFMVATL20-1250-2300**	1250	300	92.5	20	30	1200	\$81,416	\$83,940
CFMVATL20-1500-2300**	1500	360	92.5	20	30	1200	\$82,149	\$84,778
CFMVATL20-1750-2300**	1750	420	92.5	20	30	1200	\$82,175	\$85,462

\*\* Insert appropriate option code as shown below:

NEMA 12 = 12

NEMA 3R = 3R

### 4160V

Model Number	HP	FLA	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
CFMVATL20-300-4160-**	300	40	92.5	20	30	1200	\$72,688	\$74,868
CFMVATL20-750-4160-**	750	99	92.5	20	30	1200	\$76,322	\$78,612
CFMVATL20-1000-4160-**	1000	133	92.5	20	30	1200	\$79,957	\$82,355
CFMVATL20-1250-4160-**	1250	166	92.5	20	30	1200	\$80,684	\$83,185
CFMVATL20-1500-4160-**	1500	200	92.5	20	30	1200	\$81,410	\$84,016
CFMVATL20-2000-4160-**	2000	266	92.5	20	30	1200	\$81,774	\$84,472
CFMVATL20-2500-4160-**	2500	333	92.5	20	30	1200	\$81,515	\$84,205
CFMVATL20-3000-4160-**	3000	450	92.5	20	30	1200	\$82,330	\$85,047

\*\* Insert appropriate option code as shown below:

NEMA 12 = 12

NEMA 3R = 3R

## FULL VOLTAGE ATL STARTERS SERIES

### COMPACT, 'SMART' 20" WIDE ATL STARTER

*Benshaw 'Smart' 20" Wide Medium Voltage Across-The-Line (ATL) starters are full voltage motor controllers designed for those installations where space limitations call for a smaller enclosure footprint.*

*Includes Benshaw's MX<sup>3</sup> controller for advanced motor protection, metering, diagnostics and communication. See page 35 for details.*

#### KEY FEATURES

The 'Smart' medium voltage combination ATL starter includes:

- NEMA 12 or 3R enclosure
- Cable entry top
- Cable exit bottom
- Disconnect Switch
  - Load break/fault make
  - 5kV Class "R" rated fuses
  - Current limiting
  - Grounding bar
  - Viewing window
- Withstand Rating: 50kA
- 60kV BIL rating
- Vacuum motor starting contactor
- 'Smart' programmable keypad with MX<sup>3</sup> controller\*
- Start/stop push buttons (Via Keypad)
- Featured items via MX<sup>3</sup> Keypad
  - MX<sup>3</sup> Overload protection
  - Phase imbalance protection
  - Phase reversal protection
  - Phase loss protection
  - Test function/trip indication
  - Fault indication



20" Wide, 'Smart' ATL Starter



# FULL VOLTAGE ATL STARTERS SERIES - PRICING

## 20" WIDE 'SMART' ATL STARTER

### 2300V

Model Number	HP	FLA	Dimensions (in.)			Approx Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
CFMVRMXATL20-500-2300**	500	120	92.5	20	30	1200	\$74,148	\$76,348
CFMVRMXATL20-750-2300**	750	180	92.5	20	30	1200	\$77,815	\$80,125
CFMVRMXATL20-1000-2300**	1000	240	92.5	20	30	1200	\$81,482	\$83,903
CFMVRMXATL20-1250-2300**	1250	300	92.5	20	30	1200	\$82,216	\$84,740
CFMVRMXATL20-1500-2300**	1500	360	92.5	20	30	1200	\$82,949	\$85,578
CFMVRMXATL20-1750-2300**	1750	420	92.5	20	30	1200	\$82,975	\$86,262

\*\* Insert appropriate option code as shown below:

NEMA 12 = 12  
NEMA 3R = 3R

### 4160V

Model Number	HP	FLA	Dimensions (in.)			Approx Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
CFMVRMXATL20-300-4160-**	300	40	92.5	20	30	1200	\$73,488	\$75,668
CFMVRMXATL20-750-4160-**	750	99	92.5	20	30	1200	\$77,122	\$79,412
CFMVRMXATL20-1000-4160-**	1000	133	92.5	20	30	1200	\$80,757	\$83,155
CFMVRMXATL20-1250-4160-**	1250	166	92.5	20	30	1200	\$81,484	\$83,985
CFMVRMXATL20-1500-4160-**	1500	200	92.5	20	30	1200	\$82,210	\$84,816
CFMVRMXATL20-2000-4160-**	2000	266	92.5	20	30	1200	\$82,574	\$85,272
CFMVRMXATL20-2500-4160-**	2500	333	92.5	20	30	1200	\$82,665	\$85,355
CFMVRMXATL20-3000-4160-**	3000	450	92.5	20	30	1200	\$83,130	\$85,847

\*\* Insert appropriate option code as shown below:

NEMA 12 = 12  
NEMA 3R = 3R

## **FULL VOLTAGE ACROSS-THE-LINE STARTERS**

### **TWO-HIGH MEDIUM VOLTAGE SOLID STATE STARTERS**

*The Benshaw medium voltage full voltage non reversing starter configuration is also available in a two high design. The two high design in a 92.5"H x 36"W x 36"D enclosure can provide individual motor control and protection of application up to 333 Amps.*

*In each section, you will have a 400amp rated fault make load break disconnect switch, R rated motor fuses and a 400amp rated vacuum bottle contactor. Each section will have a separate 120V control section to house your choice of the Benshaw MX<sup>3</sup> control card or a third party motor protection relay.*

*The Benshaw two high section shares the same horizontal capabilities of all Benshaw MV products which allows for seamless integration into a complete solution.*

*These units are fully customizable to meeting requirements of you application.*



#### **KEY ADVANTAGES**

- Two 350% - 30 seconds rated solid state starters
- Compact footprint - use for standalone, back-to-back and MCC/lineup applications
- Dual redundant configuration (switch-selectable emergency backup full voltage starters)
- Rugged, welded enclosure with chain drive flange handle mechanism
- Benshaw's advanced, digital NX control and protection
- 50 KAIC (2600 or 4800 VAC) short circuit fault rated
- 45kV BIL
- Built-in self test features
- NEMA 1, UL 347 listed
- Bottom entrance standard
- Top entrance requires a side hat 20" or MLO



# FULL VOLTAGE ATL STARTERS SERIES - PRICING

## TWO-HIGH MEDIUM VOLTAGE SOLID STATE STARTERS

### 2-HIGH BASIC ATL

#### 2300V

Model Number	Volt	HP	FLA	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
				H	W	D			
CFMVATL2H-1000/1000-2300-**	2300	1000	240	92.5	36	36	1900	\$60,141	CF

#### 3300V

Model Number	Volt	HP	FLA	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
				H	W	D			
CFMVATL2H-1500/1500-3300-**	3300	1500	254	92.5	36	36	1900	\$60,141	CF

#### 4600V

Model Number	Volt	HP	FLA	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
				H	W	D			
CFMVATL2H-2000/2000-4160-**	4160	2000	266	92.5	36	36	1900	\$60,141	CF

### 2-HIGH SMART ATL

#### 2300V

Model Number	Volt	HP	FLA	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
				H	W	D			
CFMVRMXATL2H-1000/1000-2300-**	2300	1000	240	92.5	36	36	1900	\$69,681	CF

#### 3300V

Model Number	Volt	HP	FLA	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
				H	W	D			
CFMVRMXATL2H-1500/1500-3300-**	3300	1500	254	92.5	36	36	1900	\$69,681	CF

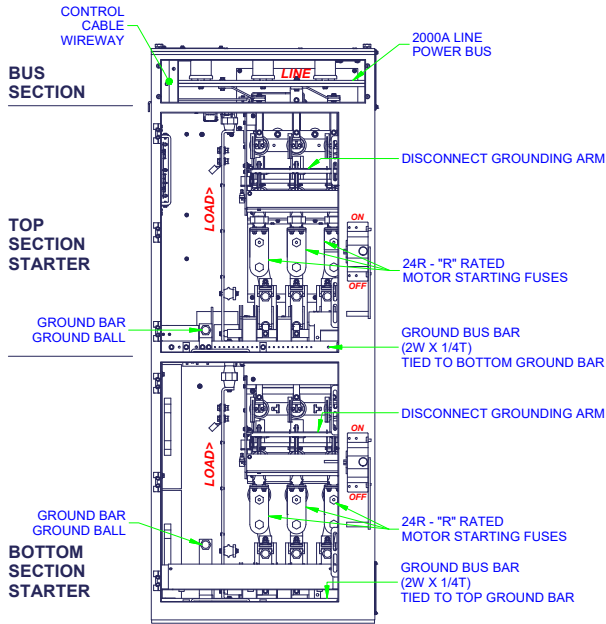
#### 4600V

Model Number	Volt	HP	FLA	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
				H	W	D			
CFMVRMXATL2H-2000/2000-4160-**	4160	2000	266	92.5	36	36	1900	\$69,681	CF

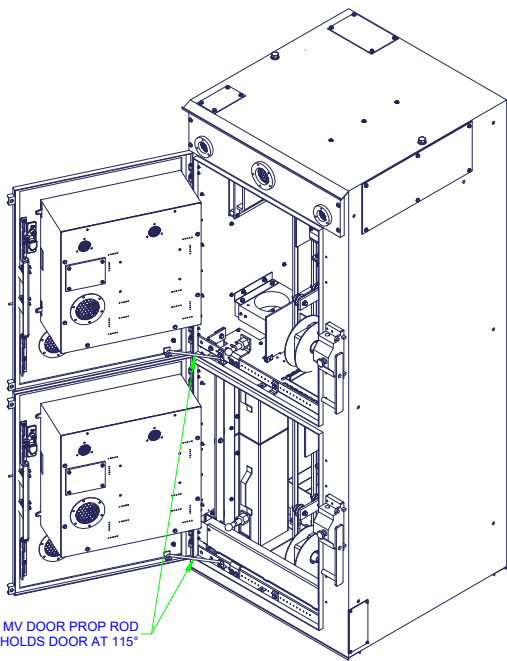
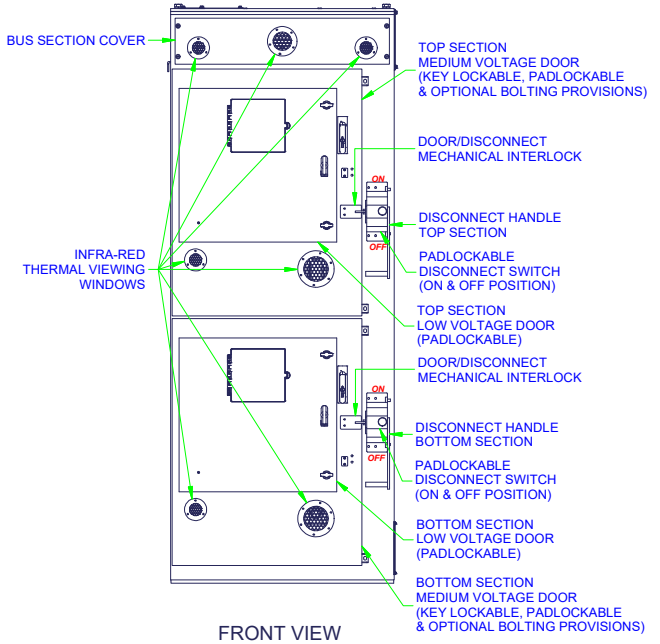
CF - Consult Factory

# FULL VOLTAGE ACROSS-THE-LINE STARTERS - DRAWINGS

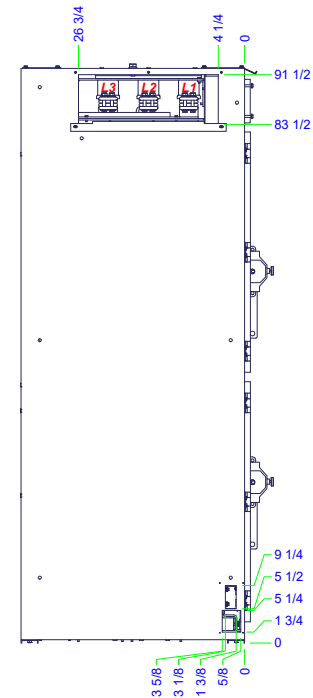
## TWO-HIGH MEDIUM VOLTAGE SOLID STATE STARTERS



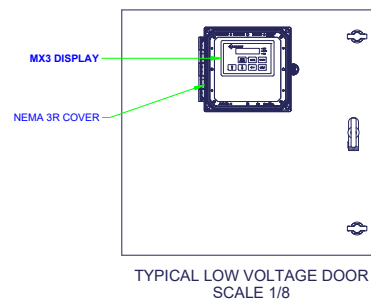
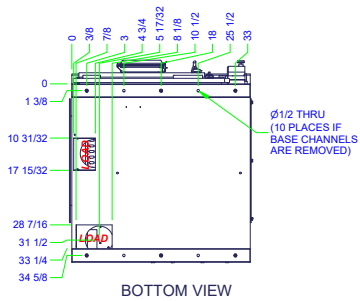
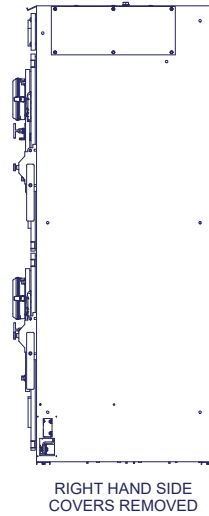
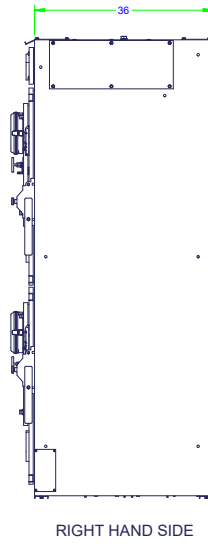
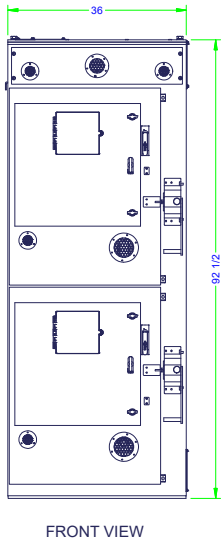
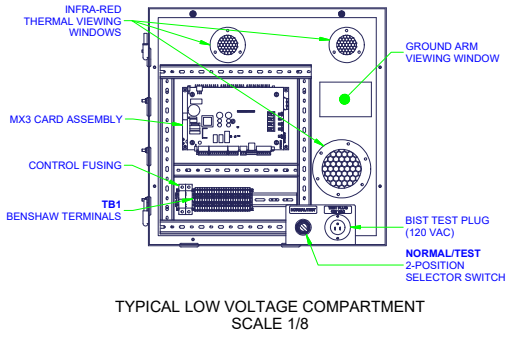
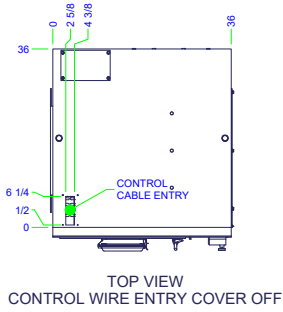
ALL DOORS REMOVED  
DISCONNECT FINGERGUARD FRONT FEM COVER  
REMOVED TO SHOW INTERNAL COMPONENTS



MEDIUM VOLTAGE DOORS OPEN  
N.T.S.



LEFT SIDE VIEW  
TOP BUS, WIREWAY  
& GROUND BUS CUTOUTS





MV Soft Starters

Full Voltage Assemblies

MV Switchgear Assemblies

Lineups/Motor Control Centers

MV Variable Frequency Drives

IEC Motor Controls

Specialty Products

Projects



**Medium Voltage Motor Control Solutions**



**SECTION 3**

**Built-to-Order Options**

- MVB1200 Main Breaker Section Draw-Out ..... 50
- MVB1200 Main Breaker Fixed Mount Option ..... 51
- Main Lug Only (MLO) ..... 52
- Main Lug Only (MLO) Pricing ..... 53
- Load Break Interrupter Switch ..... 54
- Load Break Interrupter Switch Pricing ..... 54
- MV Junction Box..... 55
- Low Profile Load Break Interrupter Switch ..... 56
- Dual Load Break Interrupter Switches..... 57

# MVB1200 SERIES

## MAIN BREAKER SECTION DRAW-OUT

### MVB1200

- Metal clad or metal enclosed
- Up to 3000A and 4160V
- 120V control section
- Isolated horizontal bus section
- Withstand rating up to 50kA
- Incoming line section option
- Arc mitigation
- Remote operator switch
- Draw-out or fixed mount CT/PT



### REMOTE OPERATORS



## MVB1200 SERIES

### MAIN BREAKER FIXED MOUNT OPTION

*A Benshaw fixed mount breaker, paired with our fault make load break disconnect switch and a third party protection relay provides you with the capabilities and operations of a circuit breaker with the reduced foot print of a disconnect section.*

*With the fixed mount design of the breaker, a fault make load break disconnect is used to provide a reliable and visual means of isolation.*

*The fixed mount circuit breaker is available in two sizes, 630A and 1250A.*

*The fixed mount breaker shares the same horizontal capabilities of all Benshaw medium voltage products which allows for seamless integration into a complete solution.*

#### FEATURES

- Breaker Lifting Device
- Breaker Test Cabinet
- Electric Remote Racking Device
- Intermediate Class Surge Arrestors
- Live Line Indicators (Located on the Load Side)
- Ground Balls (Located on the Load Side)
- Thermal Viewing Windows
- Ultrasound Ports
- Mimic Bus
  - Arc Mitigation Fibre
- Fibre controlled by SEL Relay
- Remote Breaker Control Panel
- Series 24 Electroswitch
  - 4 NO/4 NC
  - Spring Return to Off
- Red Pilot Light (Breaker Closed)
- Green Pilot Light (Breaker Open)
- Customer Use Terminal Strip Labeled 1-50
- Series 242 Electroswitch
  - Low Set Position
  - Normal Position
  - 8 NO/8 NC Contacts
  - Non Shorting

## MLO SERIES

### MAIN LUG ONLY (MLO)

*Benshaw's Main Lug Only (MLO) section provides a full height and depth NEMA rated enclosure for use as a convenient area to land the line or load cable connections while providing a transition area for a disconnect switch, starter or MCC. Required for Benshaw line-ups with bus.*

*The MLO can be configured for top or bottom cable access (specify when ordering). Customized MLO sections are available — just contact Benshaw's factory with your requirements.*

#### KEY ADVANTAGES:

- Landing pad for input cable
- Optional feed-through bus to Benshaw line up
- Top or bottom cable entry
- NEMA 1, 12 or 3R enclosure configurations
- Transition from other manufacturers' line up
- Configure to match up to existing bus network (optional)
- Optional control transformers and metering can be added
- Bottom entry standard — top entry requires upsizing to 36" W

#### STANDARD FEATURES:

The MLO Series includes:

- Landing pad for cabling
- NEMA 1/12 construction
- ANSI 61 gray
- 11 gauge steel construction
- Super durable polyurethane TGIC powder paint
- Tin-plated copper bus
- Paint finish meets ASTM A252-9 or A525-83
- UL/cUL listed 5 kV Class
- 18" MLO not UL

#### OPTIONS:

- Lockable front panel
- Bus entry, left or right
- Control wireway



## MLO SERIES - PRICING

### 2300V 18" W

Model Number	Volt	Amps	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
MVMLO18-800-2300-**	2300	800	92.5	18	30	900	\$17,659	\$19,862
MVMLO18-1200-2300-**	2300	1200	92.5	18	30	1300	\$17,841	\$20,044
MVMLO18-2000-2300-**	2300	2000	92.5	18	30	1300	\$24,776	\$26,979

### 2300V 24" W

Model Number	Volt	Amps	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
MVMLO24-800-2300-**	2300	800	92.5	24	30	900	\$20,828	\$23,030
MVMLO24-1200-2300-**	2300	1200	92.5	24	30	1300	\$21,009	\$23,212
MVMLO24-2000-2300-**	2300	2000	92.5	24	30	1300	\$27,944	\$30,147

### 3300V 18" W

Model Number	Volt	Amps	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
MVMLO18-800-3300-**	3300	800	92.5	18	30	900	\$17,659	\$19,862
MVMLO18-1200-3300-**	3300	1200	92.5	18	30	1300	\$17,841	\$20,044
MVMLO18-2000-3300-**	3300	2000	92.5	18	30	1300	\$24,776	\$26,979

### 3300V 24" W

Model Number	Volt	Amps	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
MVMLO24-800-3300-**	3300	800	92.5	24	30	900	\$20,828	\$23,030
MVMLO24-1200-3300-**	3300	1200	92.5	24	30	1300	\$21,009	\$23,212
MVMLO24-2000-3300-**	3300	2000	92.5	24	30	1300	\$27,944	\$30,147

### 4160V 18" W

Model Number	Volt	Amps	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
MVMLO18-800-4160-**	4160	800	92.5	18	30	900	\$17,659	\$19,862
MVMLO18-1200-4160-**	4160	1200	92.5	18	30	1400	\$17,841	\$20,044
MVMLO18-2000-4160-**	4160	2000	92.5	18	30	1400	\$24,776	\$26,979

### 4160V 24" W

Model Number	Volt	Amps	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
MVMLO24-800-4160-**	4160	800	92.5	24	30	900	\$20,828	\$23,030
MVMLO24-1200-4160-**	4160	1200	92.5	24	30	1400	\$21,009	\$23,212
MVMLO24-2000-4160-**	4160	2000	92.5	24	30	1400	\$27,944	\$30,147

\*\*Populate appropriate width, amps & Enclosure rating in the highlighted cells.

# CFMVDISC SERIES

## LOAD BREAK INTERRUPTER SWITCH

### MVDISC

*Benshaw's free standing medium voltage load break interrupter switch is the latest design in medium voltage high current switching equipment for a wide range of applications. The fused interrupter switch provides an economical means of disconnect and short circuit protection of medium voltage loads such as transformers, single circuit or multi-circuit systems.*

*The switch is provided in a NEMA rated enclosure configured for use as a standalone unit or in an equipment line-up (MCC).*



### KEY FEATURES

- Bolts directly to Benshaw MCC line-up or starter
- UL labeled up to 4800 volts
- Available in 400, 600 and 1200 amp ratings
- Available up to 6600 volts
- 5kV Class E/R rated fuses
- Load break rated
- Compatible for use with Class E or R rated fuses

## PRICING

### 2300V

Model Number	HP	FLA	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
CFMVDISC-24-400-2300-**	2300	400	92.5	24	30	1200	\$31,906	\$34,109
CFMVDISC-36-600-2300-**	2300	600	92.5	36	36	1200	\$51,068	\$53,271
CFMVDISC-36-1200-2300-**	2300	1200	92.5	36	36	1200	\$54,740	\$56,942

### 4160V

Model Number	HP	FLA	Dimensions (in.)			Approx. Weight (lbs.)	NEMA 12 List Price	NEMA 3R List Price
			H	W	D			
CFMVDISC-24-400-4160-**	4160	400	92.5	24	30	1300	\$31,906	\$34,109
CFMVDISC-36-600-4160-**	4160	600	92.5	36	36	1300	\$51,068	\$53,271
CFMVDISC-36-1200-4160-**	4160	1200	92.5	36	36	1300	\$54,740	\$56,942

\*\* Note: Max E rated fuses per disconnect size:  
 400A = 200E  
 600A = 600E  
 1200A = 900E (with UL); 1200E (without UL)

## MV JUNCTION BOX

### MV JUNCTION BOX

*Benshaw's Medium Voltage Junction Boxes feature heavy duty, tin-plated cooper bus bars and terminals for safe connection of medium voltage three phase circuits. The power coated steel enclosure provides plenty of room for cable routing and rugged design for use in harsh operating environments.*

#### KEY FEATURES

- NEMA 1/12 construction
- 11 guage steel construction
- Durable polyurethane TGIC powder paint
- Tin-plated cooper bus



## **FVMD SERIES**

### **LOW PROFILE LOAD BREAK INTERRUPTER SWITCH (MINI DISCONNECT)**

*Benshaw has developed a small footprint load break disconnect switch that is ideal for servicing your existing equipment. Benshaw's cost effective solution allows customers to put a maintenance disconnect directly next to the equipment using the smallest footprint. Maintenance and service employees will have line-of-sight to ensure that power is off and the equipment is safe to service. The low profile design is also ideal for environments where height is a concern, particularly in mining. The option also allows for up to 1200 A bus.*

#### **KEY ADVANTAGES:**

- Compact design saves space
- Available up to 600 A full rated amps
- Class E fusing included
- Load break rated
- Bus available for line-ups

#### **STANDARD FEATURES:**

The standard medium voltage combination "FVMD" package includes:

- Load break fault make
- 60 kV BIL
- Symmetric fault rating of 50 kA for 5 kV Class, 45 kA for 2.4 kV Class
- NEMA 12 or 3R Enclosure
- Top cable entry/bottom cable exit
- Disconnect switch:
  - Flange handle
  - Load break/fault make
  - Grounding bar
  - Viewing window
- Individual fusing
  - Class "E"
  - Blown fuse indication





## CFMVDISC2H SERIES

### DUAL LOAD BREAK INTERRUPTER SWITCHES

*Benshaw is now able to offer the same rugged and reliable disconnect design, but in a smaller package for your smaller current needs. Enclosures are available in NEMA 1 and NEMA 12 configurations.*

*The enclosure consists of two distinct compartments that are completely isolated for maintenance. Standard combination CFMVDISC2H dual load break interrupter switches are supplied with individual load break/fault make disconnect isolation switches, and Class "E" fuses available up to 200E.*

#### **KEY ADVANTAGES:**

- Bolts directly to Benshaw MCC line-up or starter
- Available up to 200 A full rated amps
- Class E fusing included
- Load break rated
- Compact designs saves space

#### **STANDARD FEATURES:**

The standard dual medium voltage combination "DISC2H" package includes:

- Load break fault make
- 60 kV BIL
- Symmetric fault rating of 50 kA for 5 kV Class, 45 kA for 2.4 kV Class
- NEMA 12 enclosure
- Two disconnect switches:
  - Flange handle
  - Load break/fault make
  - Grounding bar
  - Viewing window
- Individual fusing
  - Class "E" up to 200E max.
  - Blown fuse indication



MV Soft Starters

Full Voltage Assemblies

MV Switchgear Assemblies

Lineups/Motor Control Centers

MV Variable Frequency Drives

IEC Motor Controls

Specialty Products

Projects



***Medium Voltage Motor Control Solutions***

**SECTION 4**

**Transformer Feeders**

Transformer Feeders (2300V to 13800V).....60  
Dual Transformer Feeders (2300V to 4160V).....61

## **CFMVTF SERIES**

### **TRANSFORMER FEEDERS**

*Benshaw offers the same rugged and reliable product design as a cost-effective alternative to support transformer feeds. Enclosures are available in NEMA 1, NEMA 12 and NEMA 3R configurations. The enclosure consists of two distinct compartments with separate medium voltage and low voltage sections. Standard combination CFMVTF transformer feeds are supplied with individual load break/fault make disconnect isolation switches, Class “E” current limiting fuses, vacuum isolation contactors for shunt protection and a customer-selected feeder protection relay.*

#### **STANDARD FEATURES:**

The standard transformer feeder combination “CFMVTF” package includes:

- NEMA 1, 12, 3R enclosure
- Disconnect switches:
  - Rotary or flange
  - Load break/fault make
  - Grounding bar
  - Viewing window
- Individual line fusing
  - Class “E”
  - Current limiting
- Vacuum isolation contactor for fault shunt
- Red ON and Green OFF pilot lights
- Amber FAULT pilot light
- Customer-specified feeder protection relay with CTs and ground fault CT

# TRANSFORMER FEEDERS SERIES

## DUAL LOAD BREAK INTERRUPTER SWITCHES

*Benshaw offers the same rugged and reliable product design, but in a smaller package for smaller load requirements. Enclosures are available in NEMA 1, 12 or 3R configurations. The enclosure consists of two distinct isolated compartments for medium voltage. Standard combination CFMVDISC2H transformer feeds are supplied with two individual load break/fault make disconnect isolation switches, individual Class "E" current limiting fuses up to 200E, individual vacuum isolation contactors for shunt protection and a customer-selected feeder protection relay.*

### STANDARD FEATURES:

The standard dual transformer feeder combination "CFMVTF2H" package includes:

- NEMA 12 enclosure
- Individual disconnect switches:
  - Flange
  - Load break/fault make
  - Grounding bar
  - Viewing window
- Individual line fusing
  - Class "E"
  - Max. Rating 200E
- Individual vacuum isolation contactor
- Red ON and Green OFF pilot lights
- Amber FAULT pilot light
- Customer-specified feeder protection relay with CTs and ground fault CT for each section





MV Soft Starters

Full Voltage Assemblies

MV Switchgear Assemblies

Lineups/Motor Control Centers

MV Variable Frequency Drives

IEC Motor Controls

Specialty Products

Projects



*Medium Voltage Motor Control Solutions*

**SECTION 5**

**Application Specific Products**

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- Intelligent MV Motor Control Centers / Lineups .....65
- Main-Tie-Main Arrangements .....66
- Medium Voltage Engineering Services.....67
- Sync Transfer.....69

## **MEDIUM VOLTAGE APPLICATION-SPECIFIC PRODUCTS**

### **PRODUCT OVERVIEW**

*Benshaw is the trusted expert for any AC motor application. Benshaw provides a full line of application solutions for motors ranging from 2.3 through 15 kV Class up to 25,000 HP. Application-specific motor starters include Reversing, DC Injection Braking, Wound Rotor, Two-Speed/PAM, Synchronous, Multiple Motor, Capacitor Start/Switching Controls, Mine Duty Skid-Mounted and more.*

#### **15 KV CLASS SOLID STATE STARTERS**

- 10,000, 11,000, 13,800 volt nominal operating voltages
- Up to 30,000 HP
- Combination or non-combination configurations
- Stand-alone or motor control center lineups
- Custom enclosures and transition sections

#### **SYNCHRONOUS MOTOR SOLID STATE STARTERS**

- Soft start stator control
- Synchronous speed monitoring package
- Solid state DC field excitor
- Applications include chillers, compressors, pumps, ball mills, chippers and more

#### **SYNCHRONOUS MOTOR DC POSITIONING CONTROLS**

- Integrated synchronous motor starter
- Solid state positioning control
- Applications include cement plant ball mills, rubber mills and more

#### **TWO-SPEED/PAM MOTOR STARTERS**

- Solid state starter
- Vacuum contactors for speed changing
- Applications include power generation plant I.D fans, F.D fans, Banbury mixers and more

#### **REVERSING MOTOR STARTERS**

- Solid state starter
- Vacuum contactors for motor reversing
- Applications include aggregate crushers, shredders, rubber mills, coal mills and more

#### **WOUND ROTOR MOTOR STARTERS**

- Solid state starter
- Rotor resistors, shorting contactors and interface
- Applications in aggregate, steel, mining, paper, power generation industries and more

#### **MULTIPLE MOTOR STARTING**

- Solid state starter
- Individual motor protection
- Applications include aggregate and coal conveyors, crushers, grinders, shredders and more



## INTELLIGENT MV MOTOR CONTROL CENTERS/LINEUPS



### INCOMING SECTION(S)

- Main breakers or disconnects
- Main-tie-main (MTM) arrangements
- Main lug only sections
- 400, 600 or 1200 amp load break fault make disconnects
- Surge protection devices
- Metering and communications

### CUSTOM CONFIGURED MULTIPLE UNIT MOTOR CONTROL CENTER (MCC) LINEUPS

- Transition sections to third party equipment
- 800/1200/2000/3000 amp horizontal bus
- Reduced voltage/full voltage/feeder controls
- Back-to-back construction
- Back-to-back with bus transition (optional)

### INTELLIGENT MCC INTEGRATION

- Easy MCC networking
- MTM, disconnects, feeders; SSRV, ATL, two-speed starters
- Diagnostics and communications
- Intelligent SSRVS power poles

# MAIN-TIE-MAIN ARRANGEMENTS

## FIXED MOUNT

- Vacuum circuit breakers
- 46" deep



## FIXED MOUNT

- Fused disconnect switches
- 36" deep



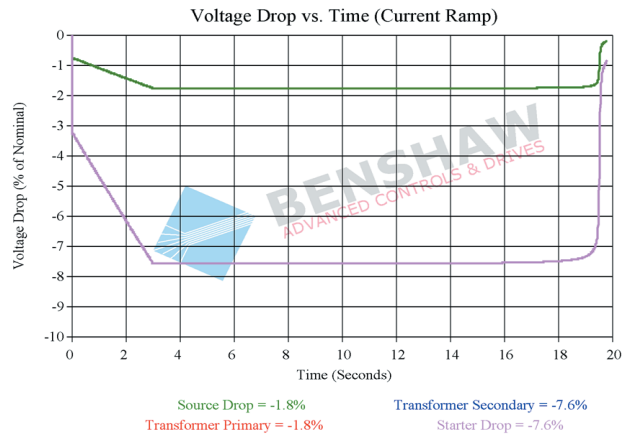
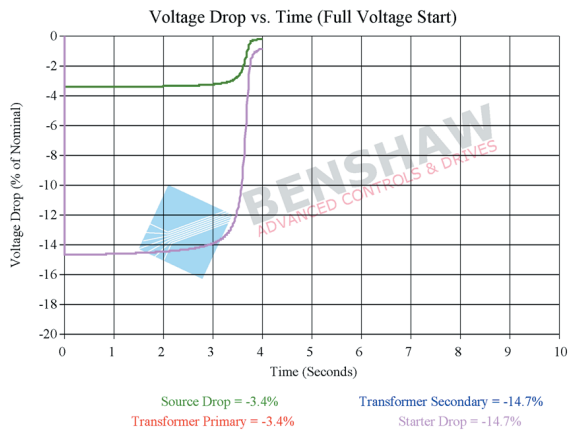
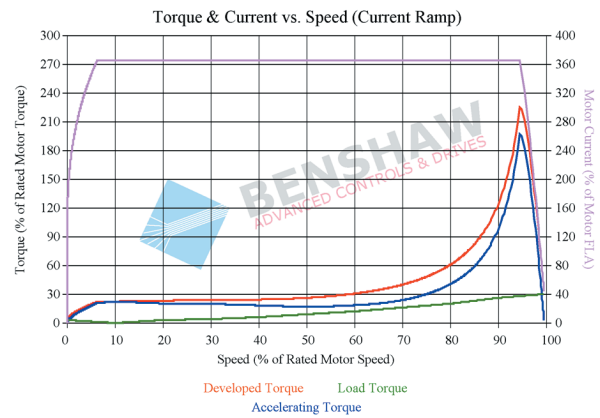
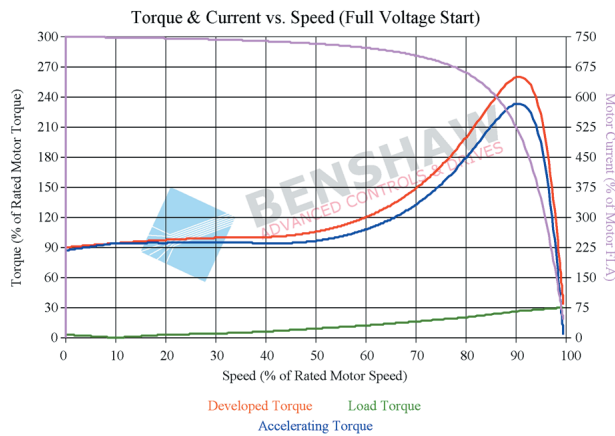
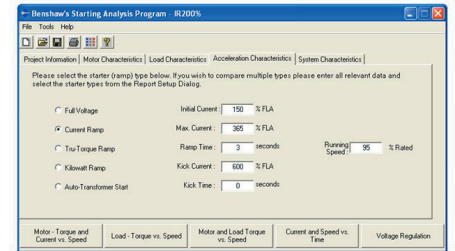
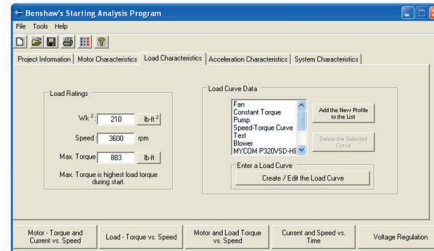
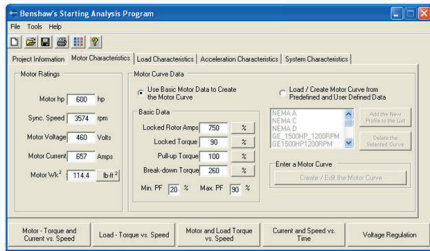
## DRAW OUT

- Vacuum circuit breakers
- 91" deep



# MEDIUM VOLTAGE ENGINEERING SERVICES

- Motor starting analysis
- System voltage drop analysis



# FOR ANY INDUSTRY

2300 V TO 13,800 V



Low profile skid-mount mining packages



Custom enclosures with transitions



15 kV Class non-combination and combination solid state starters

# SYNCHRONOUS TRANSFER

## SYNCHRONOUS TRANSFER

The Synchronous Transfer option allows the VFD motor output voltage and phasing to synchronize to that of the incoming utility supply, thus allowing the motor to be directly connected to the incoming line. This synchronization and transfer operates in a 'bump-less' manner for both VFD to Line, and Line back to VFD connection. This 'bump-less' transfer eliminates current and torque surges to the line, motor, and load system.

Benshaw offers all the isolation disconnects, contactors, synchronous reactor, synchronous controller, and motor protection relays, in multiple options and configurations for up to four (4) motors for the MVH2 series, and up to ten (10) motors for the M2L series drives, providing an easy, fast, and smooth one-stop shop experience.

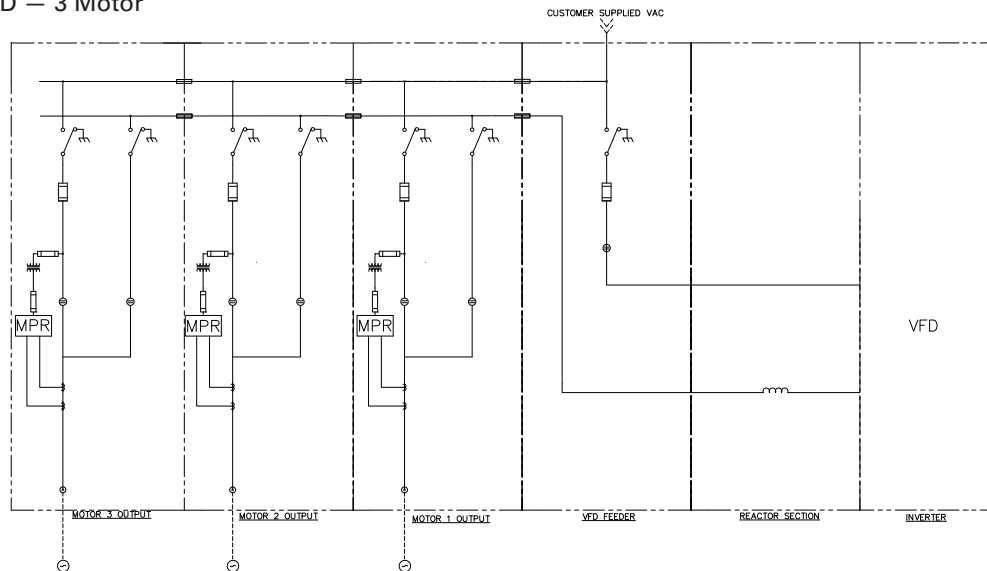
## SYNCHRONOUS TRANSFER APPLICATION

**Single VFD with Single Motor** - Single motor setup provides the ability to soft start a motor and load combination which eliminates any inrush current thus reducing the impact on weak power systems. The motor may be operated at variable speeds using the VFD or transferred across the line to operate at full speed.

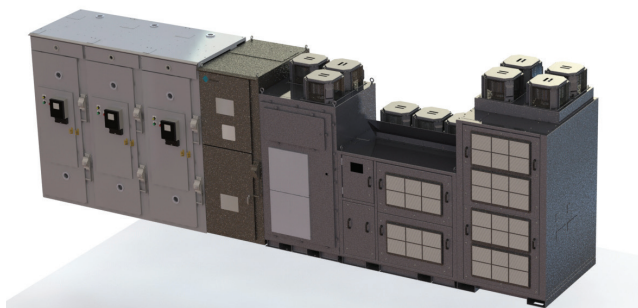
This configuration also gives the opportunity for 'Starting Duty Only' operation; where a higher FLA motor than the VFD current rating can be started unloaded (so long as the unloaded motor current is within the VFD range), transferred to the utility line, then fully loaded. This eliminates line disturbances usually associated with starting a higher HP motor conventionally and can potentially reduce VFD size.

**Single VFD with Multiple Motors** - This provides the same benefits as the single motor configuration above, but with multiple motors. Multiple motors may be transferred and maintained line transferred, in any order, each with independent motor protection, while one motor remains on VFD control for load trimming purposes.

One-Line Diagram 1 VFD — 3 Motor



Line-Up Diagram 1 VFD — 3 Motor





MV Soft Starters

Full Voltage Assemblies

MV Switchgear Assemblies

Lineups/Motor Control Centers

MV Variable Frequency Drives

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# Medium Voltage Motor Control Solutions

**SECTION 6**

**Special Application Solutions**

- Synchronous Motor Starters .....72
- Wound Rotor Starters .....74
- Wound Rotor Checklist .....75
- Multi-Motor Starters or Drives.....76
- Dual Starters.....77
- Ball Mill Inching Solutions.....78
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- Two-Speed and PAM Motors.....80
- Test Stands.....81
- Mine Skid Mounted Controls .....82

## **SPECIAL APPLICATION SOLUTIONS**

### **SYNCHRONOUS MOTOR STARTERS**

#### **WHAT IS A SYNCHRONOUS MOTOR?**

The synchronous motor functions as an induction motor during acceleration. Once the motor approaches full synchronous speed, the 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, no slip is required to produce torque, as with an induction motor. This allows the motor to run at synchronous speed.

#### **BENEFITS OF A SYNCHRONOUS MOTOR:**

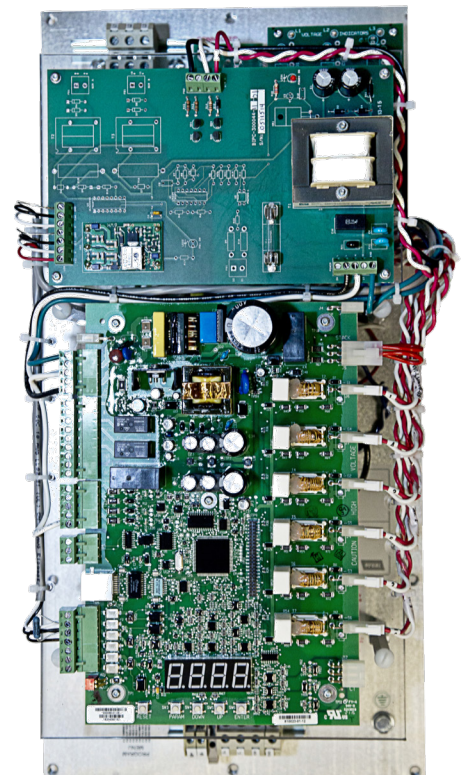
Synchronous motors are used for a numbers of reasons, including applications that require precise motor speed, to obtain increased efficiency or for power factor correction.

Since synchronous motors can be operated at leading power factor, they are used to correct a facility's lagging power factor created by other induction motors operating at the facility. This correction reduces the penalty a customer pays the utility company for poor power factor.

#### **WHY CHOOSE THE BENSHAW SYNCHRONOUS EXCITATION PACKAGE?**

The Benschaw Synchronous Excitation Package (SEP) uses Benschaw's MX<sup>2</sup> software and integrates easily with either Benschaw Controls (MX<sup>2</sup> or MX<sup>3</sup>) or any existing controller. The MX<sup>2</sup> SEP can be used with a reduced voltage solid state starter or a full voltage starter. The SEP is available for both brush-type and brushless synchronous motors.

The MX<sup>2</sup> SEP solid state synchronous control provides advanced synchronous motor protection with Modbus communication. It allows for a reduced footprint compared to existing field controls, making it beneficial for retrofit opportunities.





# SPECIAL APPLICATION SOLUTIONS

## SYNCHRONOUS MOTOR STARTERS

### SYNCHRONOUS MOTOR STARTER CHECKLIST

For a quotation on a synchronous motor starter, please complete the checklist below. The SEP can be provided as a standalone section for use with an existing starter, or can be provided as a package with a Benshaw starter. Refer to the appropriate starter section (MV or LV, RVSS or ATL) for options available on the starter section.

Horsepower \_\_\_\_\_

Voltage \_\_\_\_\_

FLA \_\_\_\_\_

Secondary Voltage: \_\_\_\_\_

Secondary Amps \_\_\_\_\_

Type:  Brushless or  Brush Type

Incoming Line Power  
 (if different from motor voltage): \_\_\_\_\_

### FOR EXISTING SYSTEMS:

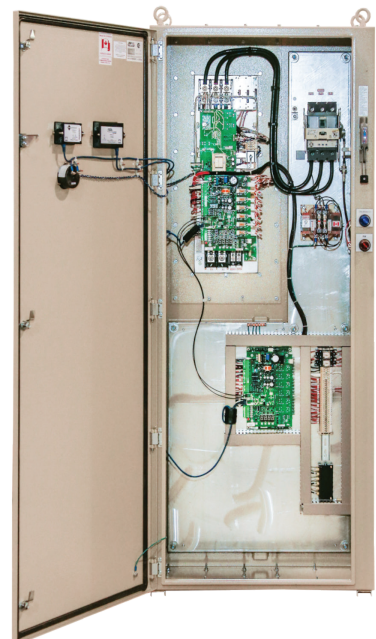
Serial Number (if Benshaw): \_\_\_\_\_

Available Footprint:

H \_\_\_\_\_ W \_\_\_\_\_ D \_\_\_\_\_

\*For Brush Type only, rating of existing Field Discharge

Resistor: \_\_\_\_\_ ohms



# SPECIAL APPLICATION SOLUTIONS

## WOUND ROTOR STARTERS

### WHAT IS A WOUND ROTOR MOTOR?

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 use an electromechanical starter on the stator and introduce multiple stages of resistance in the rotor via contactor arrangements to achieve a soft ramp.

### THE BENSHAW SOLUTION:

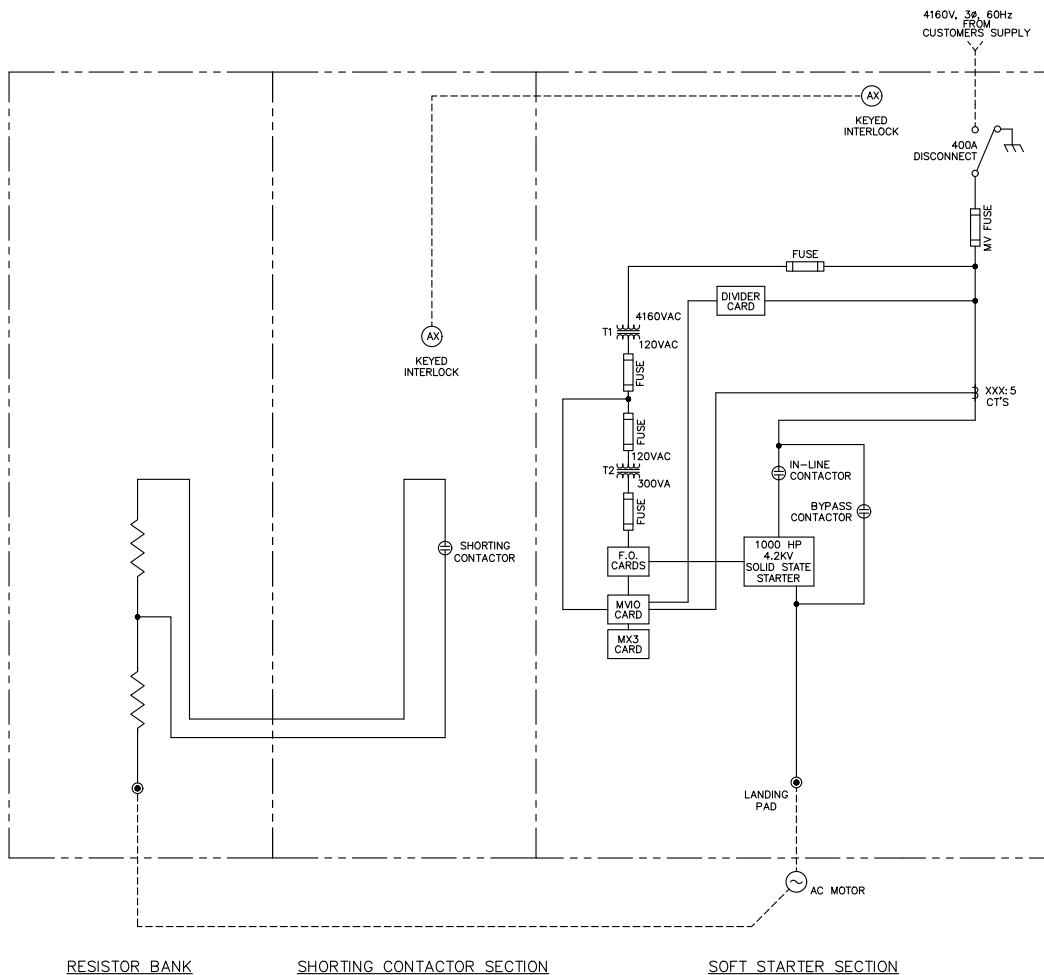
With the Benshaw MX<sup>3</sup> Solid State Starter, wound rotor control is greatly simplified. The Benshaw starter consists of two parts: a solid state starter for stator control, and a resistor bank with shorting contactors for the rotor circuit. This achieves the high torque required, with low inrush, while providing a smooth stepless start.

### 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 (as 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:

Wound Rotor RVSS starters can be supplied with multiple stages of rotor resistors and contactors. This multiple step arrangement may be necessary for starting of extremely high inertia loads, or for continuous operation at multiple speeds.



# SPECIAL APPLICATION SOLUTIONS

## WOUND ROTOR STARTERS

### WOUND ROTOR CHECKLIST:

New or  Replacement

Refer to appropriate section below (new or replacement). For additional starter options, refer to appropriate checklist (MV or LV, RVSS or ATL).

### FOR NEW INSTALLATIONS:

Horsepower \_\_\_\_\_

Voltage \_\_\_\_\_

FLA \_\_\_\_\_

Secondary Voltage: \_\_\_\_\_

Secondary Amps \_\_\_\_\_

Application: \_\_\_\_\_

Desired Controller Type (select one):

RVSS or  ATL

(Optional) Number of Steps Needed: \_\_\_\_\_

### FOR REPLACEMENT UNITS:

Horsepower \_\_\_\_\_

Voltage \_\_\_\_\_

FLA \_\_\_\_\_

Secondary Voltage: \_\_\_\_\_

Secondary Amps \_\_\_\_\_

Application: \_\_\_\_\_

Current System Info:

Controller Type (select one):

RVSS or  ATL or  VFD

Number of Steps: \_\_\_\_\_

Ratings and Timing of Resistors: \_\_\_\_\_

\_\_\_\_\_

## SPECIAL APPLICATION SOLUTIONS

### MULTI-MOTOR STARTERS OR DRIVES

*Benshaw's success in the market is a direct result of our willingness as a company to think "beyond the box." We've made systems solutions a central focus of our business, and we make learning your business a top priority. By focusing on the bigger picture, we gain a better understanding of your process, your control requirements and your market objectives.*

#### CUSTOMIZED SOLUTIONS

Benshaw takes great pride in our ability to design and deliver custom control enclosures that truly complement the form and function of your equipment. NEMA 1, 3R, 4 and 12 enclosures in unit-mount, console-mount, free-standing and wall-mount configurations are available to suit your needs.

Every MCP we design is carefully crafted to meet your dimensional requirements, prototyped and tested for fit and compliance with relevant safety standards.

#### INTELLIGENT MOTOR CONTROLS

Benshaw offers a full range of multi-motor control options including full-voltage starters, solid-state reduced-voltage starters and variable frequency drives. Reversing, two-speed, DC braking, wye-delta, synchronous and wound rotor control are also available.



#### MCP PACKAGE DESIGNED FOR YOUR APPLICATION

- Voltage Range: 230-575Vac
- Single-phase or three-phase
- Dual Rating: Normal and Heavy Duty (ND/HD)
- Main Circuit Breaker Disconnect - rotary or flange
- Enclosures: NEMA 4, NEMA 12, or NEMA 3R
- 65kA rating
- Starters: ATL, RVSS, Wye-Delta
- Drives: wide range of VFDs
- RS485 ModBus communications
- I/O and Network Expansion Options
- Multi-Language Graphical Display
- SCR Fail Power Through
- USB Port and Data Logging
- Ground Fault Option
- Service Entrance Rated Option
- Door Mounted Options: Keypads, Pilot Devices and more

# SPECIAL APPLICATION SOLUTIONS

## DUAL OUTPUT STARTERS

Dual output starters enable the use of a single SCR power section to start and stop two motors. Two versions of dual starters are available — the first has one controller, such that both motors are started and stopped at the same time, while the second has two separate MX<sup>3</sup> controllers, allowing each motor to be started and stopped separately.

This solution can provide savings from a cost and/or footprint perspective, and can be used for any voltage class.

### WHICH IS BEST FOR MY APPLICATION?

#### SINGLE CONTROLLER:

- Low horsepower ratings
- Application that requires both motors always run together
- Simple controller (no PLC coordination required)
- Identical motors

#### DUAL CONTROLLER:

- High horsepower ratings
- Application that requires one motor to start, then second motor to start after a certain amount of time
- High voltage (ideal for 15 kV Class gear)
- Motors can be of different horsepower and FLA

### CHECKLIST:

For base options and controls, refer to starter checklist.

Controller Type (select one):

Single Controller    or     Dual Controller

Footprint Restrictions:

H \_\_\_\_\_ W \_\_\_\_\_ D \_\_\_\_\_

Application: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Average Starts per Hour: \_\_\_\_\_

## **SPECIAL APPLICATION SOLUTIONS**

### **BALL MILL INCHING SOLUTION**

#### **WHAT IS A BALL MILL?**

Ball mills are used in many industries to grind coarse material into a finer powder. A ball mill typically consists of a horizontal cylinder, partly filled with steel balls, that rotates on its axis, imparting a tumbling and cascading action to the balls.

#### **CHALLENGE:**

When it comes time to service the mill, an access hatch must be positioned to allow technicians to enter the mill and for the ball charge to be changed. Positioning a hatch is accomplished by a process known as spotting or inching. Without a dedicated inching system, it can be difficult to precisely position the mill, since the technician has no way to accurately and effectively apply torque to the motor directly from the power system.

Traditional positioning technology involves delivering a switched DC current to the stator windings in a specific pattern to simulate the sinusoidal AC wave form applied during normal operation while keeping the field excited. In addition to the issue of precisely moving the bulky mill, the cogging or abrupt starting and stopping of the motor can cause mechanical and electrical damage to the equipment. This, along with full voltage starting, stresses the overall electromechanical system and can cause excessive downtime, interfering with production.

#### **SOLUTION:**

Benshaw has applied low voltage AC Variable Frequency Drives to replace DC contactors and cam switch for positioning. The low voltage AC VFD has the capability to provide full torque at zero speed to start and rotate the mill during the positioning process. The use of a drive also provides speed adjustability to a maximum speed of 2–12 Hz depending on motor voltage. This allows the maintenance setup and process time to be significantly reduced. The drive replaces the obsolete and unsupported cam switch, and eliminates DC contactors and associated contact maintenance.

Due to Benshaw's full portfolio of low and medium voltage VFDs, solid state and full voltage starters, Benshaw is able to provide a full solution to replace obsolete ball mill controls. This includes a solid state or full voltage starter, all necessary isolation and the low voltage VFD for inching.

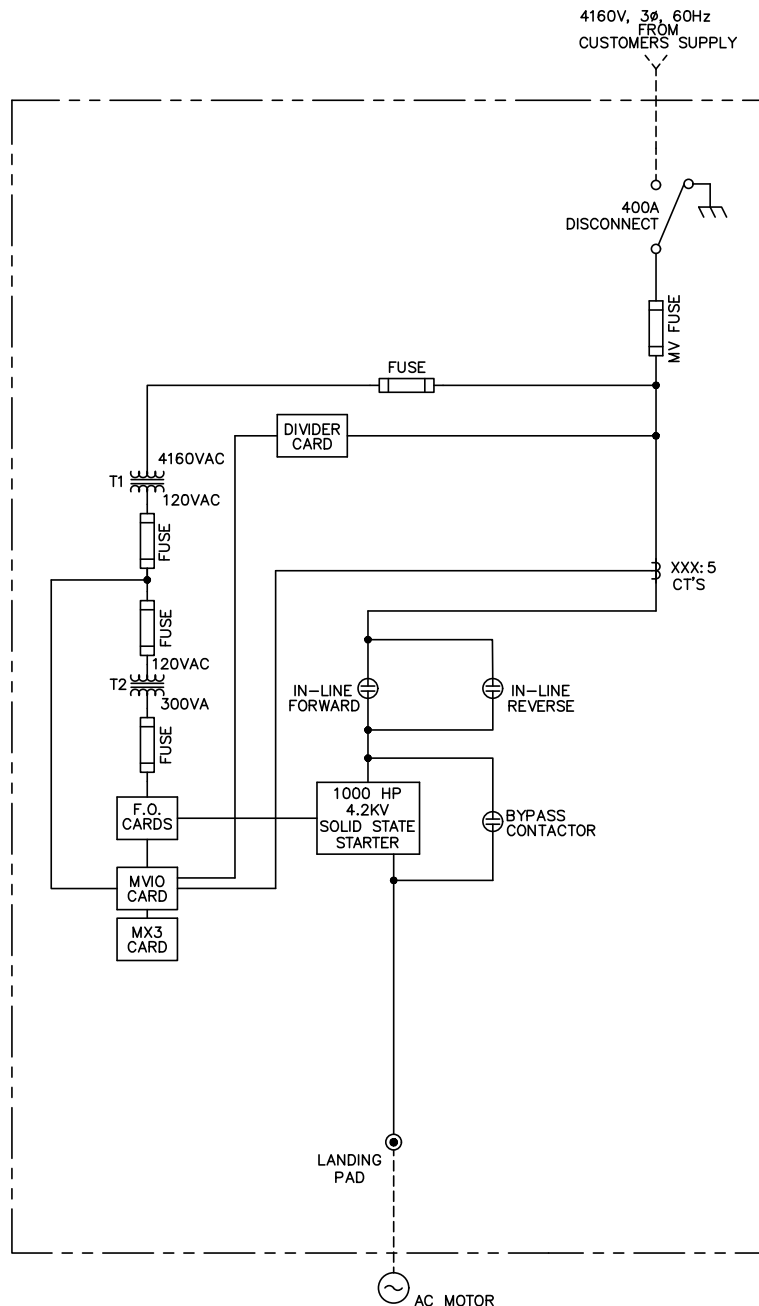
# SPECIAL APPLICATION SOLUTIONS

## REVERSING STARTERS

### WHAT IS A REVERSING STARTER?

A reversing starter is used for applications with forward/backward or upwards/downwards movement needed for operation. The reversing starter contains two contactors — labeled or defined as “Forward” and “Reverse”. It includes a selector switch for Forward or Reversing. The starter accelerates via the SCR power stacks and then transfers to the bypass contactor for running, in the same manner as the non-reversing starter.

When requesting a quotation, you must specify reversing capability to have the additional contactor included.



# SPECIAL APPLICATION SOLUTIONS

## TWO-SPEED AND PAM MOTORS

### WHAT IS A TWO-SPEED OR PAM MOTOR?

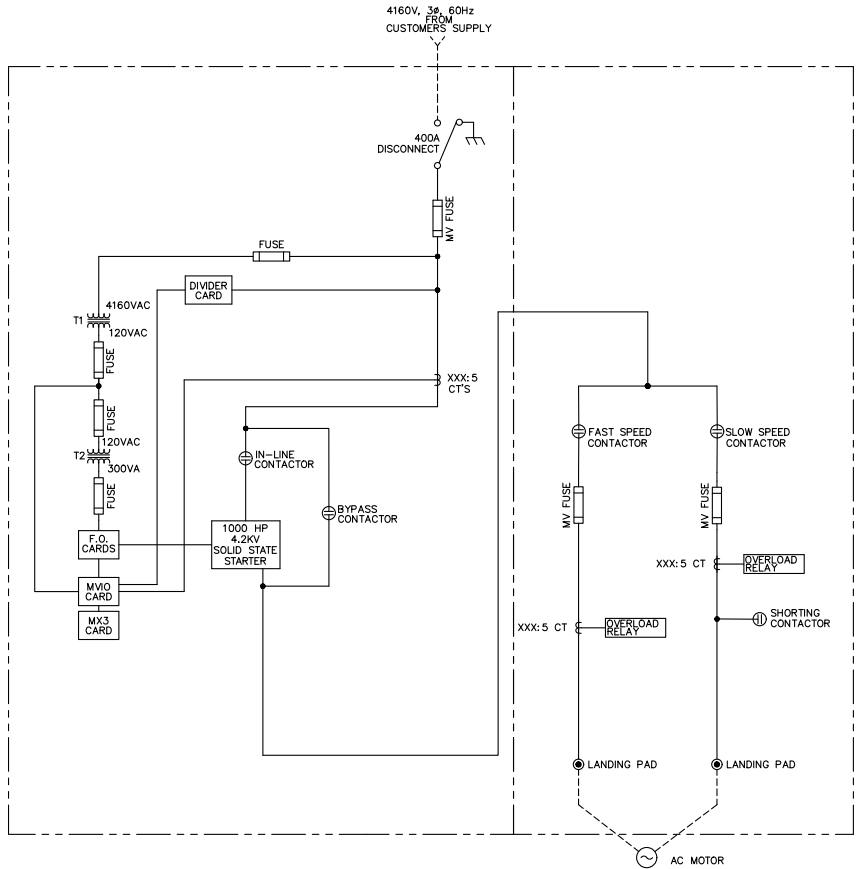
A two-speed motor is a type of induction motor with one or two windings that can operate at two different speeds. A PAM motor is a type of two-speed motor with one winding.

### WHAT ADDITIONAL CONTROLS ARE NEEDED?

The starter requires the addition of a fast speed and slow speed contactor plus additional controls for each speed mode (fast and slow).

The fast and slow speed contactors are interlocked so that only one can operate at any time. This can easily be added to Benshaw's solid state starter.

Depending upon size, this can be included in the starter enclosure or mounted in a separate enclosure.



### CHECKLIST:

For base starter options, refer to starter checklist.

In addition to the standard starter checklist, the following additional information is required for two-speed motor starters:

Voltage: \_\_\_\_\_

#### Slow Speed:

Horsepower: \_\_\_\_\_

RPM: \_\_\_\_\_

FLA: \_\_\_\_\_

#### Fast Speed:

Horsepower: \_\_\_\_\_

RPM: \_\_\_\_\_

FLA: \_\_\_\_\_



# SPECIAL APPLICATION SOLUTIONS

## TEST STANDS

Benshaw offers medium and low voltage test stands for your facility's needs.

Test stands are available with the following features:

- Full Voltage (ATL): Good for testing of motor with a starter or VFD
- Soft Starter (RVSS): Good for motor testing
- Medium or Low Voltage
- Single or Multiple Incoming Voltages
- Single or Multiple Output Voltages

### CHECKLIST:

Please complete this checklist for Application Engineering to determine the best test standard configuration for your facility's needs.

For additional starter options, refer to starter checklist.

Function of Test Stand: \_\_\_\_\_

Horsepower and Voltage Range (specify the min. and max. HP for each voltage):

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Desired Controller Type (select one):

RVSS or  ATL

Incoming Line (select one):

One Input Line (adjustable upstream voltage) or  One Line per Voltage Rating

Requirements (select one):

None or  Input Isolation (Circuit Breaker for LV, Fused Disconnect for MV)

Enclosure Type (select one):

12  3R  4  Other (specify): \_\_\_\_\_

Maximum Available Footprint:

H \_\_\_\_\_ W \_\_\_\_\_ D \_\_\_\_\_

### For Replacement of Existing:

Existing Type (select one):

ATL  RVSS  Other (specify): \_\_\_\_\_

Describe any specific functionality, controls, run time, etc. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

# SPECIAL APPLICATION SOLUTIONS

## MINE SKID MOUNTED CONTROLS



400A / 5kv "Mini" - Dimensions : 64"H x 25"W x 27"DDIN, E or R Fuse style – Max. 200E / 24R50ka w/ fuses / 14ka w/o fuses



600A or 1200A / 5kv "Mega Mini" - Dimensions : 78"H x 34"W x 34"DDIN, E or R Fuse style – Max. 500E R50ka w/ fuses / 38ka w/o fuses



600A or 1200A / 15kv - Dimensions : 92.5"H x 45"W x 50"DDIN or Bolt in Fuses

**SECTION 7**

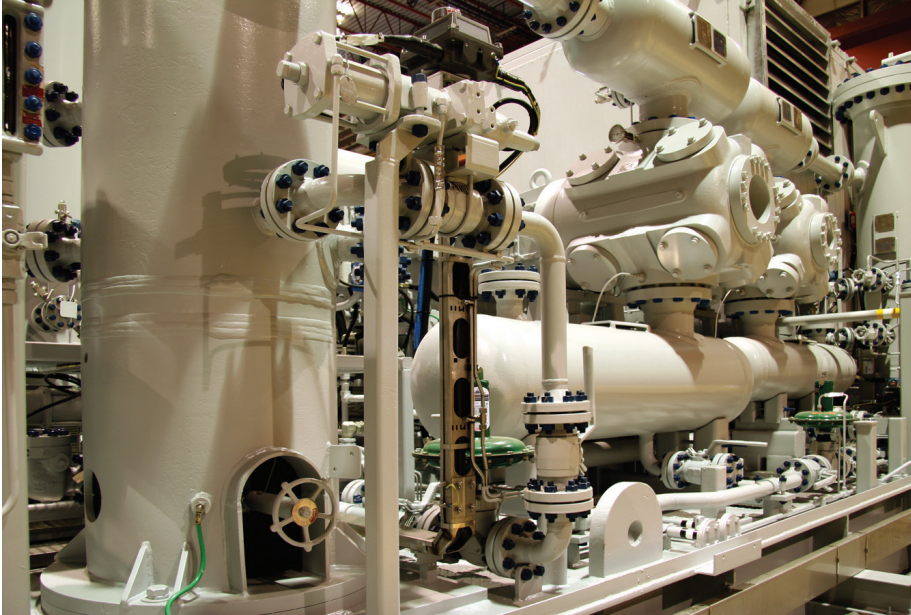
**Retrofits**

Benefits of Retrofitting .....84

Emergency Retrofits - MX<sup>3</sup> Upgrades.....85

Engineered Retrofits .....89

## **BENEFITS OF RETROFITTING**



Benshaw offers a wide variety of solutions to all of your retrofit needs. Our team of Application Engineers and Service Technicians will review your current equipment and provide recommendations to upgrade your existing equipment with minimal cost and impact. Benshaw is able to reuse existing equipment, enclosures and stub-ups from a variety of different manufactures. For very intricate projects, Benshaw will send an engineering or technical representative to your site to obtain full measurements and understand the scope. Benshaw will then design a custom retrofit to fit your needs and your budget. Before you spend significant money to replace existing working equipment, contact Benshaw to see what our team can do for you.

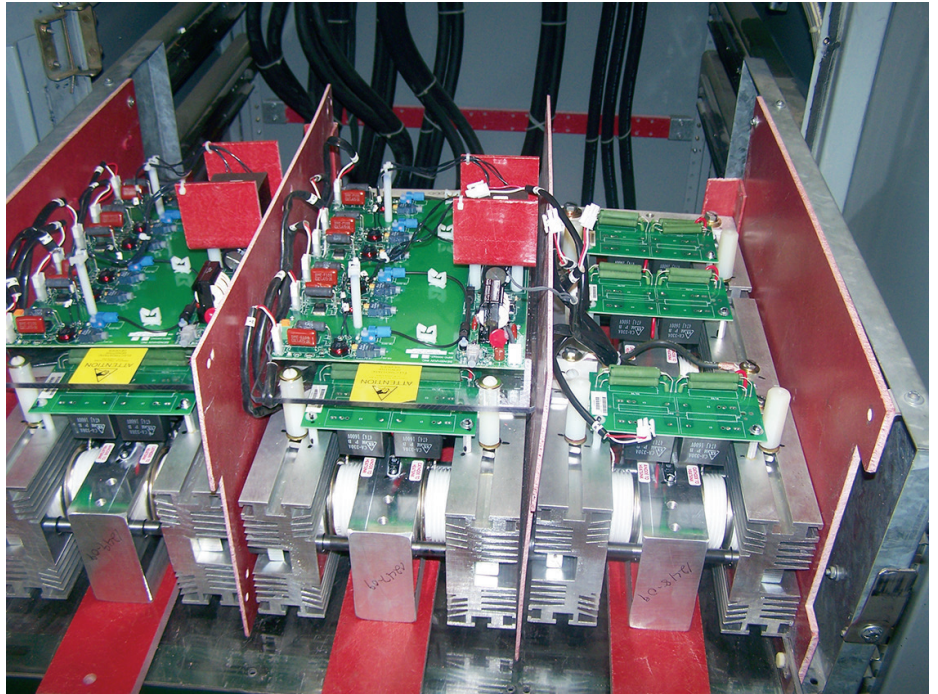
Equipment in heavy industry is expected to work for 20+ years. While it is often the case that medium voltage equipment can operate for long periods of time, many other factors change during that time period. Electrical costs and penalties go up, requiring more efficient equipment. Innovation in monitoring and protection features makes modern equipment safer for personnel and for mechanical equipment. Maintenance parts become more expensive and obsolete to the point where critical operations could face significant downtime due to a minor part failure. Full replacements of large equipment are significantly more expensive than just cost of disposal,

new installation and wiring can cause the scope to creep up to 3x or more the cost of the equipment alone. Starters, switchgear and MCCs include many expensive power components, and it's wasteful to throw out working, operational equipment to gain new features. Often, the entire factory or equipment room was designed around the existing equipment. Putting in a brand-new line-up could be a logistical nightmare. Benshaw understands the need to upgrade equipment for modern features and serviceability, without investing in a large CapEx project.



## EMERGENCY RETROFITS - MX<sup>3</sup> UPGRADES

Benshaw stocks standardized low and medium voltage kits for retrofits to upgrade your equipment in an emergency situation to the latest MX<sup>3</sup> technology, and offers engineered retrofits for units that do not require the time-sensitive urgency of emergency kits. Benshaw's qualified team of Application Engineers will review your equipment and verify that the quick-ship retrofit will work in your situation. For situations where a customized solution better fits your needs, the Application Team will provide a quote to meet your specifications.



The emergency quick-ship retrofit is available for both low and medium voltage starters, but at this time is not available for all product types.

It is intended to replace:

- Benshaw soft starters using the following control board platforms: AK, DMS, Micro II and MX
- Examples of part numbers begin with:
  - LV: RSM6, RS6, RSD6, RSE6, RXE6, RCM, RBM1, RBM2, RBM3, RC2, TBX, TCX, RBX, MXPC, MXPB, RBX2, RBX3,
  - MV: MVRSE12, MVRSE18, MVRSM12, MVRSM18

Note: This is not a complete list of model numbers. Additional model numbers may qualify.

It is not intended to replace:

- OEM specialty product lines
- Synchronous motor starters utilizing Benshaw supplied field controls
- Enclosures less than 36" wide (for MV)
- DC injection braking or reversing units

Note: These products can be retrofitted with Benshaw's engineered retrofit solution.

# EMERGENCY RETROFITS - MX<sup>3</sup> UPGRADES

To determine if your starter is applicable, please complete the checklist and contact the Benshaw Inside Sales Team.

**EXISTING STARTER INFORMATION:**

SERIAL NUMBER: \_\_\_\_\_

MODEL NUMBER: \_\_\_\_\_

HORSEPOWER: \_\_\_\_\_

VOLTAGE: \_\_\_\_\_

ENCLOSURE SIZE: \_\_\_\_\_ H: \_\_\_\_\_ W: \_\_\_\_\_ D: \_\_\_\_\_

**Y**  **N** Verify available depth from the existing control board mounting surface to the inside of the enclosure door. Approximately four inches (4") is required for the MX<sup>3</sup> control boards.

**Y**  **N** Verify if Benshaw BIBPC-720LT (L or T) integral contactors are included in chassis. (LV only)

**Notes:**

If enclosure does not have sufficient depth, the MX<sup>3</sup> control boards may be mounted in another location. SCR leads may be extended to a maximum of 6 feet. MX<sup>3</sup> control board must be located in an enclosure section that contains only low voltage power. MX<sup>3</sup> control board should not be mounted in sections with medium voltage power.

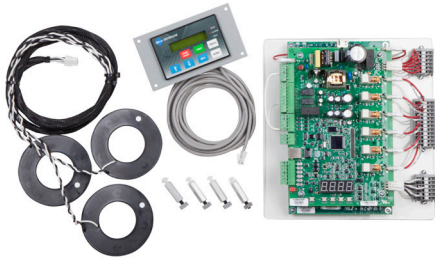
If possible, take photos of the control boards and heatsink/CR assemblies.

If yes to BIBPC contactors, customer can replace entire chassis, or purchase a separate definite purpose or full rated contactor for separate mounting (space permitting).

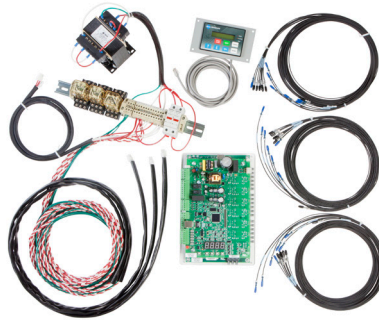
**ADDITIONAL CUSTOMER NOTES:** \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

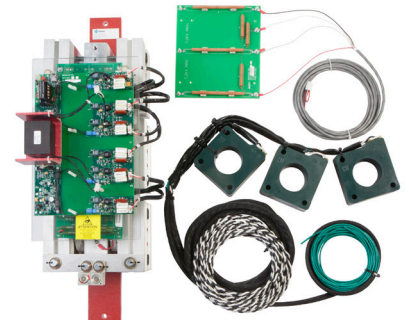
# EMERGENCY QUICK-SHIP RETROFITS - MX<sup>3</sup> UPGRADES



Low Voltage Retrofit Kit



Medium Voltage Control Section



Medium Voltage Power Section

## KIT COMPONENTS:

### RTFT-490000-00 LV RETROFIT KIT ASSEMBLY

- NEMA 3R keypad
- Keypad mounting plate
- Keypad 3 meter cable with ferrite
- MX<sup>3</sup> control card on Lexan<sup>®</sup> mounting plate
- MX<sup>3</sup> LV manual
- MX<sup>3</sup> LV installation guide

### RTFT-490001-00 MV RETROFIT KIT ASSEMBLY

- NEMA 3R keypad
- Keypad mounting plate
- Keypad 3 meter cable with ferrite
- MX<sup>3</sup> control card on Lexan<sup>®</sup> mounting plate
- 415 A power stacks (qty. 3)
- Terminal strip with terminals, relays and wiring
- 120:24 VAC control power transformer
- Fiber optic kit
- CT assembly (see following page for part numbers)
- MX<sup>3</sup> MV manual
- MX<sup>3</sup> MV installation guide

## AVAILABLE KITS

Part Number	Description
RTFT-490000-00	LV Retrofit Kit Assembly
RTFT-490001-00	MV Retrofit Kit Assembly

## EMERGENCY RETROFITS - MX<sup>3</sup> UPGRADES

### LV CURRENT TRANSFORMER (CT) KITS - REQUIRED WHEN REPLACING RS6AK CONTROL BOARD

Part Number	Description	Motor FLA
CT-420000-00	288:1 with Plug-in Connector	15–64
CT-420000-01	864:1 with Plug-in Connector	45–190
CT-420000-02	2640:1 with Plug-in Connector	135–590
CT-420000-03	5760:1 with Plug-in Connector	295–1285

Each CT kit includes a set of three CTs.

### MV CT ASSEMBLIES

Part Number	Description	Motor FLA
CT-450001-01	50:5 with MV Sleeving	11–45
CT-450002-01	150:5 with MV Sleeving	46–135
CT-450003-01	250:5 with MV Sleeving	136–225
CT-450009-01	400:5 with MV Sleeving	226–360
CT-450010-01	600:5 with MV Sleeving	361–540

Each kit includes three CTs.

CTs do not need to be ordered separately.



## ENGINEERED RETROFITS

*For units that do not qualify for the Emergency Quick-Ship Retrofit program, Benshaw also offers engineered retrofit solutions. Engineered retrofits allow for full customization, which can provide expedited installation time, add or change the control logic, or even retrofit non-Benshaw units.*

### UNITS THAT QUALIFY FOR THE ENGINEERED RETROFIT PROGRAM:

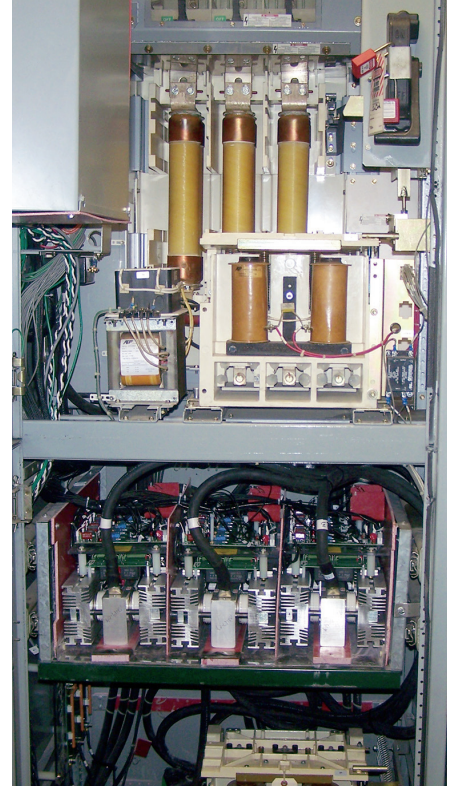
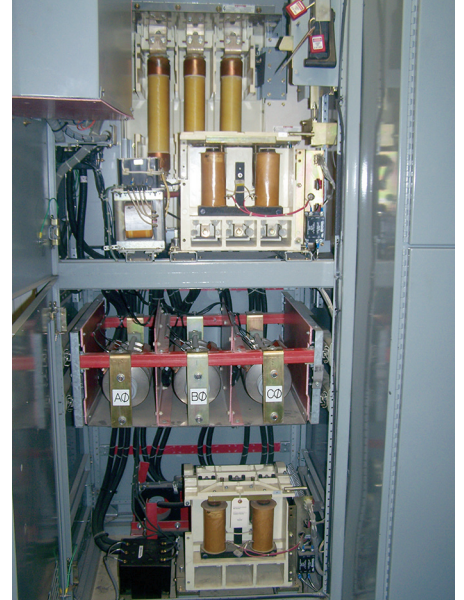
- Synchronous starters using Benshaw-supplied field controls
- Benshaw starters rated above 4800 V
- Benshaw starters rated for greater than 3000 HP at 4160 V
- Non-Benshaw starters

### PROCESS:

To receive a quotation, please provide the following information to the Benshaw Sales Team:

- Serial number (for Benshaw units)
- Drawings (for non-Benshaw units)
- Model number
- Equipment rating (HP, voltage, FLA)

Upon review by the Benshaw Inside Sales and/or Application Engineering team, a quotation will be issued, or a site visit will be requested if additional details are needed.





MV Soft Starters

Full Voltage Assemblies

MV Switchgear Assemblies

Lineups/Motor Control Centers

MV Variable Frequency Drives

IEC Motor Controls

Specialty Products

Projects



# Medium Voltage Motor Control Solutions

**SECTION 8**

**MVCB Series**

- [Product Overview](#) ..... 92
- [Selection Chart](#) ..... 93
- [Metal-Clad Single Unit](#) ..... 94
- [Metal-Clad Dual Unit](#) ..... 95
- [Pilot Devices](#) ..... 96
- [CB Accessories](#) ..... 96
- [Bus/Line Options](#) ..... 96
- [Protection Relays](#) ..... 96

## **MVCB SERIES**

### **MEDIUM VOLTAGE SWITCHGEAR**

#### **MVCB SERIES PRODUCT HIGHLIGHTS**

*Benshaw's free-standing medium voltage switchgear is the newest product in our portfolio, offering the same rugged and reliable design and performance of all our medium voltage products. To ensure the safety of personnel servicing the equipment, all Benshaw's medium voltage switchgear offerings include a rack-out circuit breaker design.*

*A remote breaker control panel and arc flash sensing options are also available to further enhance personnel safety. In addition, Benshaw offers a full metal-clad switchgear solution.*

*The switchgear is provided in a NEMA-rated enclosure configured for use as a stand-alone unit, in an equipment line-up or an MCC. Benshaw switchgear connects seamlessly to the rest of the Benshaw MCC for a space-saving design to feed line-ups or in jumbo starter solutions.*

*The Benshaw Application and Engineering Support team is available to customize switchgear designs to meet customers' specific application needs without extended lead times.*



#### **KEY ADVANTAGES:**

- Bolts directly to Benshaw MCC line-up or starter
- CSA special inspection
- Available in 1200 A or 2000 A standard (3000 A option is custom)
- Feeder protection included as standard — customer to specify manufacturer
- Available up to 13.8 kV
- Configurable with added options
- Rack-out design standard
- Remote breaker control panel

#### **STANDARD FEATURES**

- 40 kA fault rated
- Rack-out design
- NEMA 1A indoor enclosure
- Welded 11 gauge steel construction
- Feeder protection with CPT and PT
- Green open pilot light
- Red closed pilot light
- Amber trip pilot light
- Open push-button
- Closed push-button
- Manual racking device
- Bus rated to CB size
- Line power top entry standard
- Load power top exit

# MVCB SERIES

## 5KV CLASS SWITCHGEAR

The MVCB series of switchgear features a draw-out circuit breaker design.

### 2300 V

Model Number	Description	Volts	CB Frame	Dimensions (in.)		
				H	W	D
MVCB-1200-2300-**	MV CB 1200 A Top Entry/Top Exit	2300	1200	92.5	64	62
MVCB-2000-2300-**	MV CB 2000 A Top Entry/Top Exit	2300	2000	92.5	64	62

\*\* Insert appropriate option code as shown below:

- NEMA 1 = 1
- NEMA 12 = 12
- NEMA 3R = 3R

### 3300 V

Model Number	Description	Volts	CB Frame	Dimensions (in.)		
				H	W	D
MVCB-1200-3300-**	MV CB 1200 A Top Entry/Top Exit	3300	1200	92.5	64	62
MVCB-2000-3300-**	MV CB 2000 A Top Entry/Top Exit	3300	2000	92.5	64	62

\*\* Insert appropriate option code as shown below:

- NEMA 1 = 1
- NEMA 12 = 12
- NEMA 3R = 3R

### 4160 V

Model Number	Description	Volts	CB Frame	Dimensions (in.)		
				H	W	D
MVCB-1200-4160-**	MV CB 1200 A Top/Bottom Entry/Top Exit	4160	1200	92.5	64	62
MVCB-2000-4160-**	MV CB 2000 A Top/Bottom Entry/Top Exit	4160	2000	92.5	64	62

\*\* Insert appropriate option code as shown below:

- NEMA 1 = 1
- NEMA 12 = 12
- NEMA 3R = 3R

## MVCB-MC SERIES

### METAL-CLAD SERIES - SINGLE UNITS

*Benshaw can provide a complete draw-out metal-clad design requiring rear access. For the single units, a draw-out CPT and PT are located in the top section, and the circuit breaker is located in the bottom section. The design allows for top or bottom entry and center exit bus. Custom 300 A breakers are available by request. For all other configurations, consult Benshaw.*

#### 2300 V

Model Number	Description	Volts	CB Frame	Dimensions (in.)		
				H	W	D
MVCB-1200-2300-MC	MV CB 2300 V 1200 A	2300	1200	95	36	91
MVCB-2000-2300-MC	MV CB 2300 V 2000 A	2300	2000	95	36	91

#### 4160 V

Model Number	Description	Volts	CB Frame	Dimensions (in.)		
				H	W	D
MVCB-1200-4160-MC	MV CB 4160 V 1200 A	4160	1200	95	36	91
MVCB-2000-4160-MC	MV CB 4160 V 2000 A	4160	2000	95	36	91

#### 6600 V

Model Number	Description	Volts	CB Frame	Dimensions (in.)		
				H	W	D
MVCB-1200-6600-MC	MV CB 6600 V 1200 A	6600	1200	95	36	91
MVCB-2000-6600-MC	MV CB 6600 V 2000 A	6600	2000	95	36	91

#### 13800 V

Model Number	Description	Volts	CB Frame	Dimensions (in.)		
				H	W	D
MVCB-1200-13800-MC	MV CB 13800 V 1200 A	13800	1200	94	36	94
MVCB-2000-13800-MC	MV CB 13800 V 2000 A	13800	2000	94	36	94

# MVCB-MC SERIES

## METAL-CLAD SERIES - DUAL UNITS

*Benshaw's dual unit design allows the customer to stack circuit breakers two high. The design includes two enclosures sized at 36"W. The CPTs and the PTs will be in the second enclosure. The switchgear is a fully draw-out metal-clad design requiring rear access. The design allows for top or bottom entry and center exit bus. For other configurations, consult Benshaw.*

### 2300 V

Model Number	Description	Volts	CB Frame	Dimensions (in.)		
				H	W	D
MVCB-1200/1200-2300-MC	MV CB 2300 V 1200 A Top/CB 1200 A Bottom	2300	1200/1200	95	72	91
MVCB-1200/2000-2300-MC	MV CB 2300 V 1200 A Top/CB 2000 A Bottom	2300	1200/2000	95	72	91
MVCB-2000/2000-2300-MC	MV CB 2300 V 2000 A Top/CB 2000 A Bottom	2300	2000/2000	95	72	91

### 4160 V

Model Number	Description	Volts	CB Frame	Dimensions (in.)		
				H	W	D
MVCB-1200/1200-4160-MC	MV CB 4160 V 1200 A Top/CB 1200 A Bottom	4160	1200/1200	95	72	91
MVCB-1200/2000-4160-MC	MV CB 4160 V 1200 A Top/CB 2000 A Bottom	4160	1200/2000	95	72	91
MVCB-2000/2000-4160-MC	MV CB 4160 V 2000 A Top/CB 2000 A Bottom	4160	2000/2000	95	72	91

### 6600 V

Model Number	Description	Volts	CB Frame	Dimensions (in.)		
				H	W	D
MVCB-1200/1200-6600-MC	MV CB 6600 V 1200 A Top/CB 1200 A Bottom	6600	1200/1200	95	72	91
MVCB-1200/2000-6600-MC	MV CB 6600 V 1200 A Top/CB 2000 A Bottom	6600	1200/2000	95	72	91
MVCB-2000/2000-6600-MC	MV CB 2300 V 2000 A Top/CB 2000 A Bottom	6600	2000/2000	95	72	91

### 13800 V

Model Number	Description	Volts	CB Frame	Dimensions (in.)		
				H	W	D
MVCB-1200/1200-13800-MC	MV CB 13800 V 1200 A Top/CB 1200 A Bottom	13800	1200/1200	95	72	91
MVCB-1200/2000-13800-MC	MV CB 13800 V 1200 A Top/CB 2000 A Bottom	13800	1200/2000	95	72	91
MVCB-2000/2000-13800-MC	MV CB 13800 V 2000 A Top/CB 2000 A Bottom	13800	2000/2000	95	72	91

## MEDIUM VOLTAGE SWITCHGEAR OPTIONS

### PILOT DEVICES

Part Number	Description
B100	Green Open Pilot Light
B101	Red Closed Pilot Light
B102	Amber Trip Pilot Light
B103	Open Push-Button Raised
B104	Closed Push-Button Flush
B105	Fault Reset Push-Button
B110	Hand-Off-Auto Selector Switch
B111	Local-Off-Remote Selector Switch
B112	Key Operated Hand-Off-Auto Selector Switch

### CB ACCESSORIES

Part Number	Description
B120	Breaker Lift Truck
B121	Breaker Test Cabinet
B122	Remote Racking Device

### BUS/LINE OPTIONS

Part Number	Description
B130	Mimic Bus
B131	Insulated Bus Covering — 1200 A Rated
B132	Insulated Bus Covering — 2000 A Rated
B133	Ground Balls
B134	Live Line Indications
B140	Surge Arrestors, 2300 VAC
B141	Surge Arrestors, 4160 VAC
B142	Surge Arrestors, 6900 VAC
B143	Surge Arrestors, 12000 VAC

### PROTECTION RELAYS

Part Number	Description
B200	Mutlilin 850 — Feeder Protection
B201	Multilin PQM — Power Quality Monitoring
B202	Multilin 845 – Transformer Feeder Protection
B203	Multilin 369 — Motor Protection
B204	Multilin 869 — Advanced Motor Protection
B205	Schweitzer SEL-751 — Feeder Protection
B206	Schweitzer SEL-735 — Power Quality Monitoring
B207	Schweitzer SEL-787 — Transformer Feeder Protection
B208	Schweitzer SEL-849 — Motor Protection
B209	Schweitzer SEL-710 - Advanced Motor Protection

Other options are available. Please contact the Benschaw Application Engineering team.

Benschaw installs but does not program any third party relays.



**SECTION 9**

**Medium Voltage IEC Soft Starters**

- Product Overview .....98
- Specifications.....98
- Arc Fault .....100
- Design Detail .....101
- Configuration .....102
- Technical Data .....103

# L - SERIES MVE

## IEC TYPE TESTED SOFT STARTER

*The Benshaw MVE L-Series soft starter is a powerful and reliable solution for your arc resistant, Type tested IEC application requirements.*

*Extensive personal safety features, an easy-to-use graphical interface, and comprehensive built-in motor/load protection make this a well balanced solution for your medium voltage needs. MVE brings together sophisticated soft start motor control functionality in a robust yet compact physical configuration.*

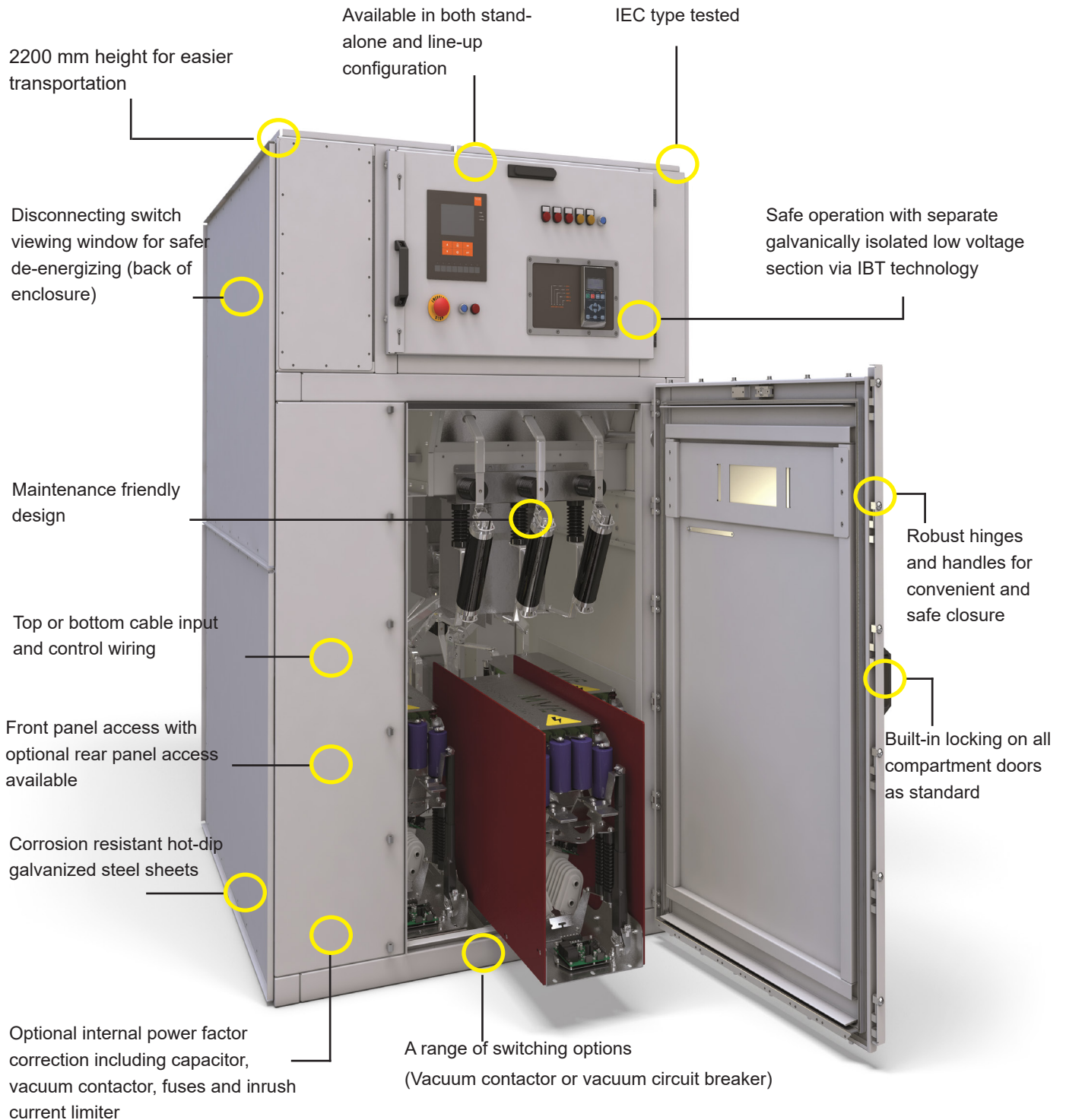
*MVE is available as a fully-furnished, Type tested cabinet. In addition to standard packages, we can supply a complete line-up to meet your requirements.*

## L - SERIES SPECIFICATIONS

- Rated voltage: 3.6 kV - 17.5 kV
- Rated busbar current: Up to 2000 A
- Rated short time withstand current / peak:
  - Up to 40 kA for 1 second / 104 kA
- Internal arc fault IAC classification:
  - AFL 31.5 kA for 1 second
  - Partition classification: PM
- Loss of service continuity: LSC1 / LSC2 / LSC2B
- IP4X protection rating (IP54 optional)
- Altitude: < 1000 m (higher with derating)
- Ambient temperature: -10 °C - 60 °C  
(Above 50 °C with derating)
- Color painting: RAL7035 (other colors optional)

# L - SERIES MVE

## IEC TYPE TESTED SOFT STARTER



## L - SERIES MVE

### ARC FAULT

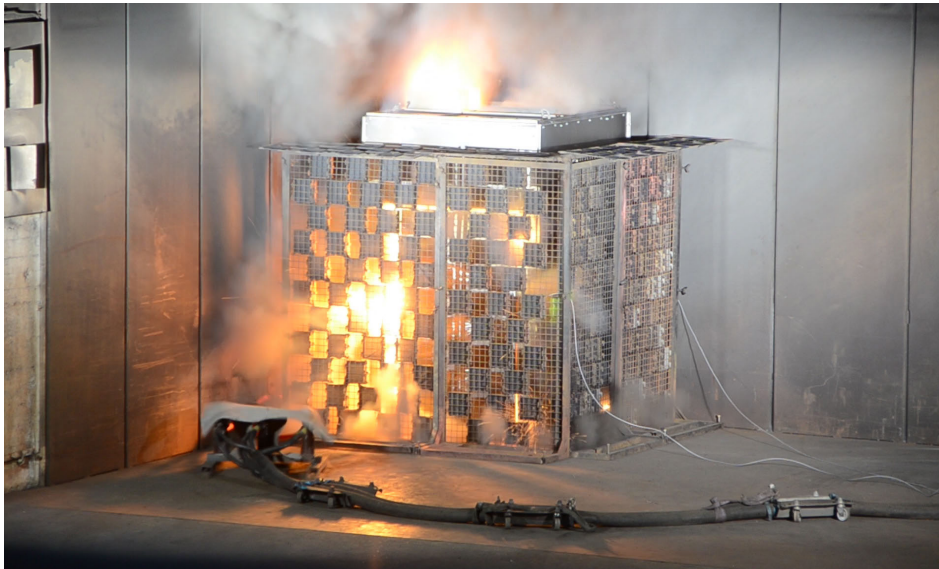
#### ARC FAULT

An arc fault is a high power discharge of electricity between two or more conductors. Such arc events can reach temperatures of over 10,000 °C - hot enough to liquefy ceramics, plastics and metal. During an arc event, the arc fault causes a sudden increase in pressure, followed by an expansion and emission phase and, finally, a thermal phase. This combination of pressure and heat can blast debris and combustible gas outward with extreme force.

The internal pressure against the weakest points of the enclosure (e.g. windows, hinges and joints) can destroy an electrical enclosure and may cause serious or fatal injury to nearby personnel.

Arc faults can occur for a number of reasons including overvoltage, faulty insulation, mechanical failure or failure of a fuse.

Due to the significant risk of serious injury or death that an arc fault presents, responsible specifiers should ensure that they require all switchgear to meet the IEC 62271-200 standard.



#### L - SERIES ARC FAULT PROTECTION

If an arc event occurs within a Benshaw L-Series starter, the arc fault is contained by solid locking doors and heavy double layer compartment panels.

During the emission phase, the pressure is safely released using discharge flaps on the top of the panel (or optional ducts), which direct the explosion upwards or vent it safely outside.

#### Fully type tested.

**Benshaw L-Series panels are fully type tested according to IEC 62271-200:**

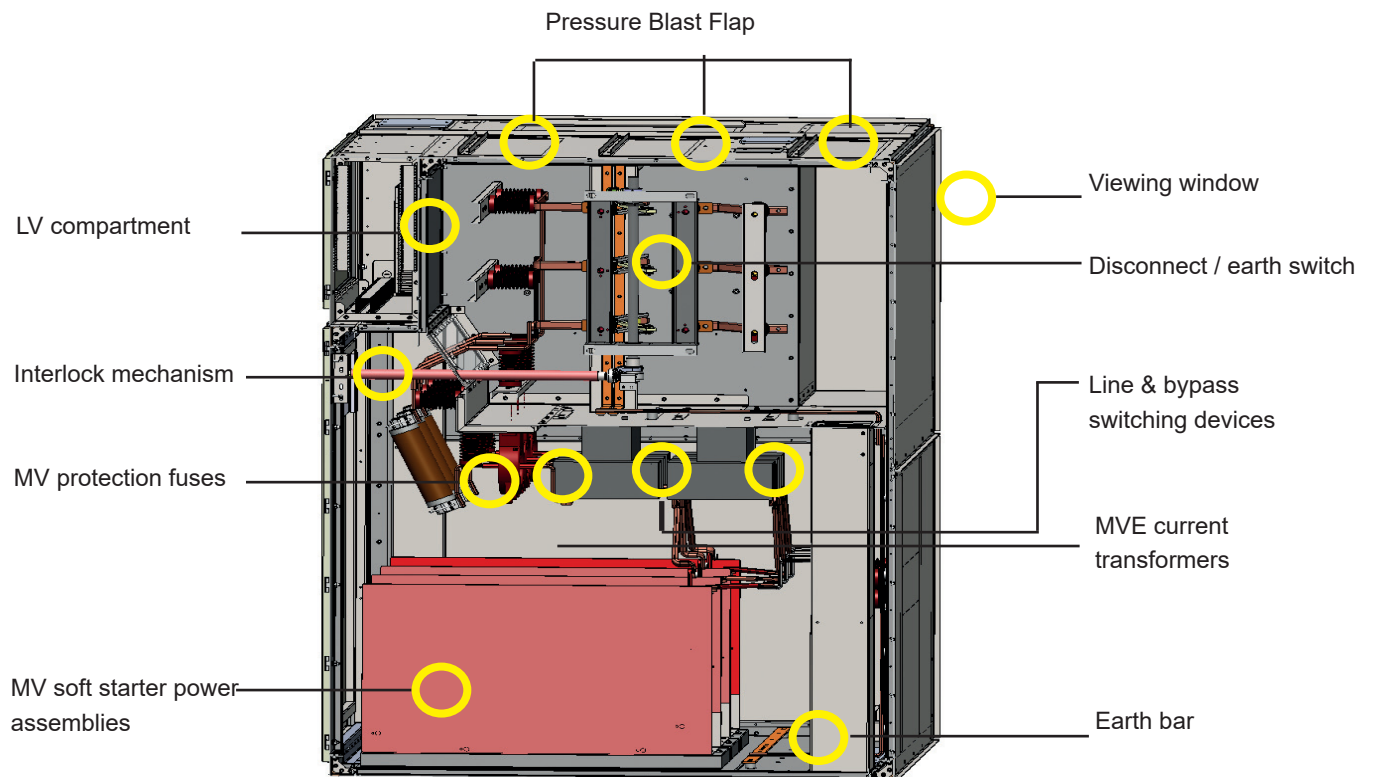
- **Short time withstand current**
- **Peak withstand current**
- Internal arc fault {IAC classification: ALF 31.5 kA for 1 second}
- Dielectric test on main and auxiliary circuits
- IP rating
- Temperature rise test related to 50 °C ambient temperature and main circuit resistance

Certificates are available from Benshaw on request.

# L - SERIES MVE

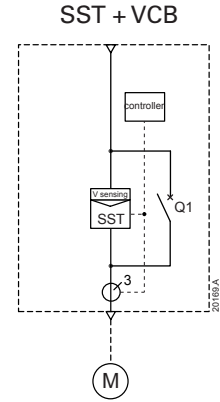
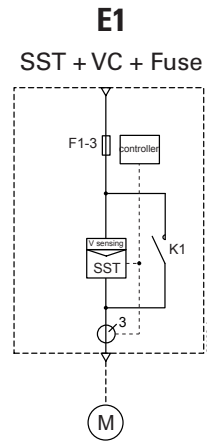
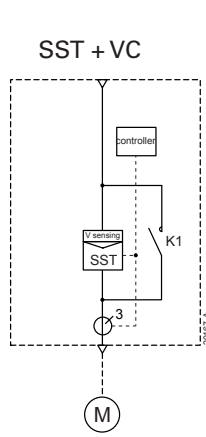
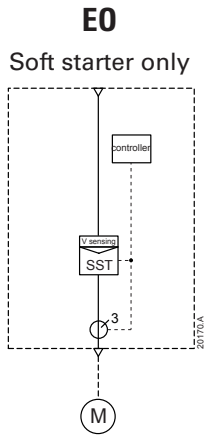
## DESIGN DETAILS

L - Series MVE design is available in either IP4X or IP54 panel, with options for line and bypass devices, earthing and isolation switches. Benshaw can also design and build panels to meet particular specifications, and we offer full application engineering support at all stages of the design process.

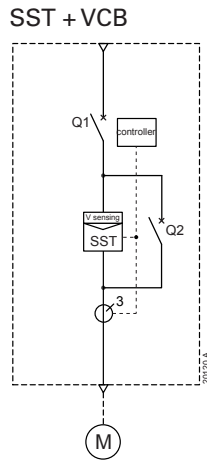
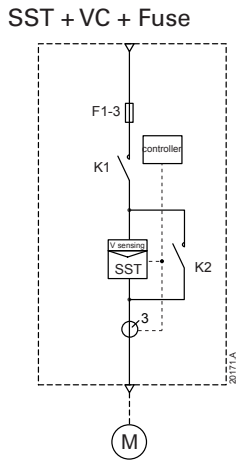
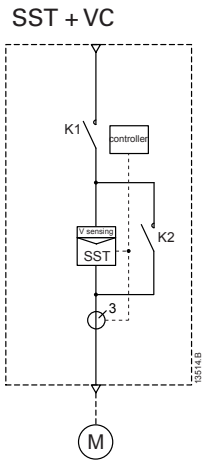


	Height (mm)	Width (mm)		Depth (mm)		E3 + PFC
		E1/E2	E3	E1/E2	E3	
L-MVE-XXXXX-V02	2200	1000	1200	1400	1600	1600
L-MVE-XXXXX-V03						
L-MVE-XXXXX-V04						
L-MVE-XXXXX-V06	1150	1400	1400	1600	1600	1600
L-MVE-XXXXX-V11						
L-MVE-XXXXX-V13						

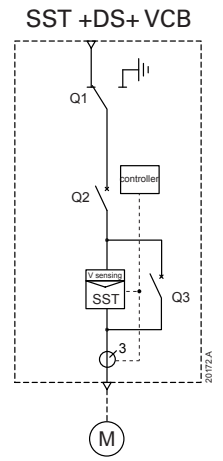
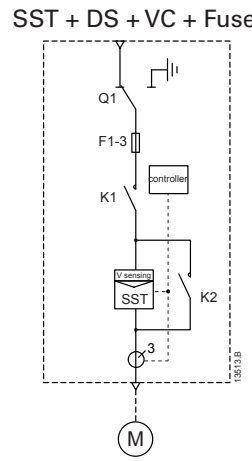
# L - SERIES CONFIGURATIONS



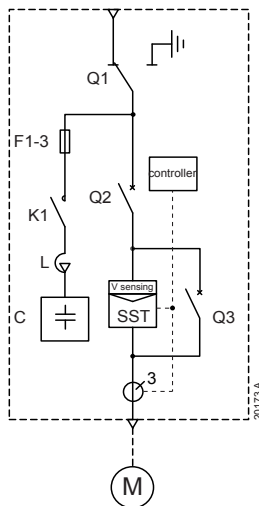
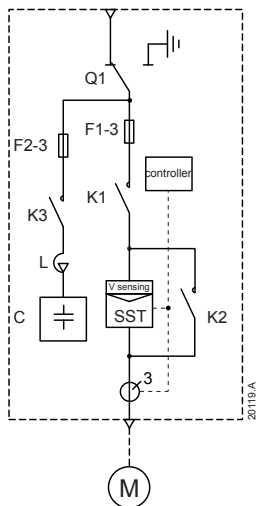
**E2**



**E3**



**E3**



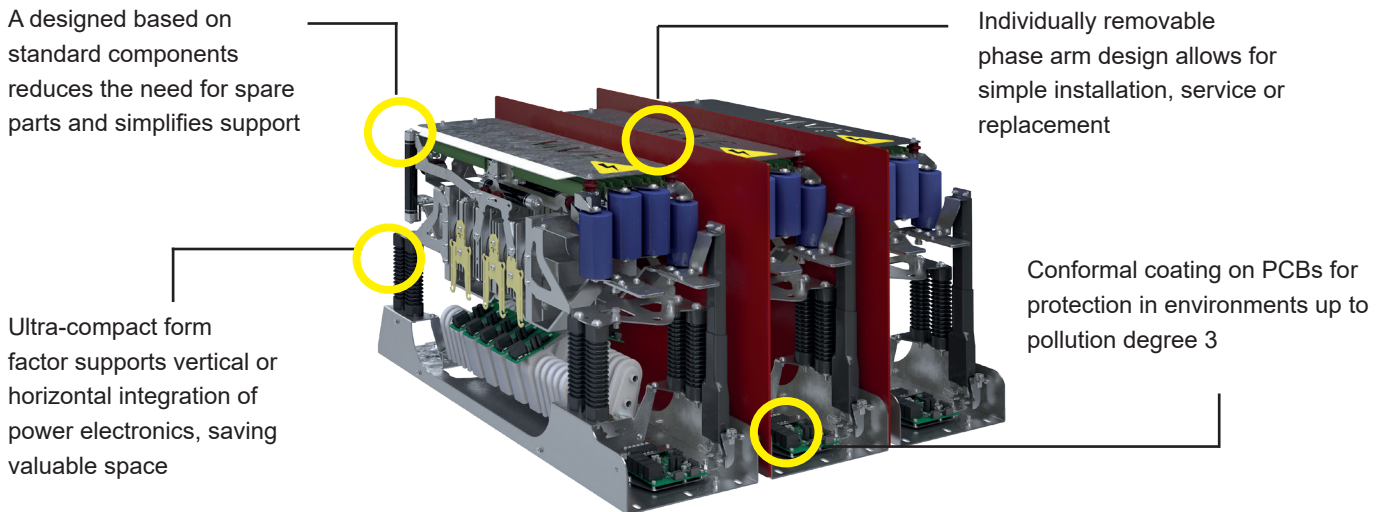
**LEGEND**

<b>Controller</b>		Controller
<b>F</b>		MV Fuses
<b>MVE</b>		MVE soft starter with voltage sensing
<b>K</b>		Vacuum contactor
<b>Q</b>		Vacuum circuit breaker
<b>Q</b>		Disconnecting switch
		3 current transformer
<b>L</b>		Inrush current limiter
<b>C</b>		Capacitors

# L - SERIES MVE

## POWERFUL AND RELIABLE

*Every application is different, and selecting the right starter for the job can sometimes seem like a daunting task. Variables such as altitude, ambient temperature, load and starts per hour all affect selection of the ideal motor starting solution. At benshaw, we employ sophisticated engineering tools to help you select the right MVE starter for your site conditions. No matter the application, you can trust our team of experienced motor control professionals to get your motor running smoothly.*



## TECHNICAL DATA

Motor voltage:	2.3 - 13.8 kV
Control voltages:	85 - 264 VAC or 90 - 350 VDC
Frequency:	45/66 Hz (auto-trigger)
Starter current:	70 A - 1700 A
Starting time (max):	1 second - 30 seconds (180 seconds)
Ambient temp. (max):	-10°C to 60 °C (above 50 °C with derating)
<b>Maximum altitude:</b>	1000 m (higher with derating)
IP rating (power assembly):	IP00
IP rating (controller):	IP54 / NEMA12
CT type:	Standard MV CTs (adjustable ratio)
VT type:	EPT type
MV/LV isolation:	100% fiber optic connection
Digital input	3 fixed (start, stop, reset), 2 programmable (A,B)
Relay output:	4 fixed (line, bypass, PFC, PAPS), 3 programmable (A,B,C)
Analog output:	1 analog output
Communications I/O:	Modbus RTU, Modbus TCP, Profibus, Profinet, DeviceNet, Ethernet/IP, USB

## L - SERIES MVE

### TAKE CONTROL FROM THE START

Medium voltage installations are complex enough without making the starter hard to use as well.

MVE is packed with features designed to make your life easier, including real-language feedback messages, so you don't have to look up codes to know what's happening.

Built-in monitoring and indicators, and extensive on-board input and output functionality reduce the need for space and avoid the cost of auxiliary equipment, while simplifying installation.

Real-time graphs of motor operating performance and current quickly and clearly illustrate exactly how your motor is performing.

No fuss, no trouble - a smoother start in every sense.

The MVE controller features simple, plain language feedback on the soft starter's operation and events - no need for trip code look-ups.

### METERING FUNCTIONALITY:

- Motor current
- Motor voltage
- Mains frequency
- Motor pd
- Motor kW
- Motor HP
- Motor temperature
- kWh
- Hours run
- Real-time graphs





# L - SERIES MVE

## RELY ON MVE

<b>Feature</b>	<b>Benefit</b>
Quick Application Setup	Easy commissioning
Multi-language Graphical Display	Ease of use and communication
Dual Motor Set	Allows for two different starting and stopping motor data sets
Starting and Stopping Options	A range of starting methods including current based torque control make the MVE soft starter suitable for all applications
Simulation Mode	Fast and easy testing during installation and commissioning without the need for a mains supply or motor
Real-time Performance Graph	Real-time graphs of motor performance and current quickly and clearly illustrate how your motor is performing
<b>Diagnostic Tool</b>	Recorded waveforms can help diagnose conditions interfering with operation
LV/MV Isolation via IBT Technology	Benshaw IBT Interface Board Technology isolates the core starter control system and HMI from the MV power section, creating a safer work environment
LV Motor Test	Conduct factory testing of motor protections via an external system such as Omicron
Secondary Injection Testing	Allows full testing without the need for a medium voltage motor or supply
Secondary Injection Testing	Allows full testing of motor protections via an external system such as Omicron
Complete Motor Protection	A wide range of protection features including ground fault protection ensure that your equipment can operate safely even in the most demanding environments
DOL+Mode	Protects your motor even while operating in bypass mode
Advanced Thermal Modeling	Intelligent thermal modeling allows the soft starter to dynamically calculate motor temperature and determine whether the motor can start successfully

## L - SERIES MVE

### PROTECTION FUNCTIONALITY

<b>Description</b>	<b>Built-in Protection</b>	<b>ANSI Code</b>
Maximum start time	<b>Excess start time</b>	48
Too many starts	Restart delay and dynamic thermal model	66
Undercurrent	Undercurrent	37
Overcurrent - jam (Locked rotor, load increase)	Instantaneous/time-delay overcurrent	50/51/51R
Overcurrent - (short circuit)	Instantaneous /time-delay overcurrent (stage 2)	50/51
Checking or Interlocking relay	Shorted SCR	3
Thermal overload	Thermal overload - dynamic model	49/51
Current imbalance	Current imbalance	46
Undervoltage	Undervoltage	27
Overvoltage	Overvoltage	59
Phase loss	Phase loss	47
Phase sequence	Phase sequence	47
Power loss	Power loss	32
<b>Ground fault</b>	<b>Ground fault</b>	50G
<b>Mains frequency</b>	<b>Frequency check, frequency variation</b>	81
External communications failure	Communication failure	85
Ext. Fault 1/code - 1	Auxiliary trip A	94/95
Ext. Fault 2/code - 2	Auxiliary trip B	94/95
Motor over temperature	Thermistor protection*	23
Stator winding over temperature	Thermistor protection*	49

\*RTD Relay is optional.

**SECTION 10**

**Arc Resistant Designs - Medium Voltage RVSS/ATL Options**

- Pilot Devices ..... 108
- Control Options..... 109
- Enclosure Options ..... 110
- Options ..... 111
- Surge/Lightning Arrestors and Surge Capacitors ..... 112
- Line Reactors..... 113
- Disconnect Switch Section Option..... 114

## MEDIUM VOLTAGE RVSS/ATL OPTIONS

### PILOT DEVICES

#### Pushbuttons

Part Number	Description	Color	List Price
A001	Raised Stop Pushbutton	Red	\$125
A002	Flush Start Pushbutton	Green	\$125
A003	Jog Pushbutton	Yellow	\$125
A004	OL Reset Pushbutton (For External OL)	Black	\$125
A005	Reset Pushbutton	Black	\$125
A006	Raised Pushbutton - Specify Function	Specify	\$125
A007	Flush Pushbutton - Specify Function	Specify	\$138
A008	Mushroom Head Stop Pushbutton	Red	\$164
A009	Illuminated Pushbutton - Specify Function	Specify	\$250

#### Pilot Lights

Part Number	Description	Color	List Price
A021	Run Light	Red	\$180
A022	Stop Light	Green	\$180
A023	Fault Light	Amber	\$180
A024	Ready Light	Green	\$180
A025	Bypass Light	Amber	\$180
A026	Specify Function	Red	\$190
A027	Specify Function	Green	\$190
A028	Specify Function	Amber	\$190
A029	Specify Function	White	\$190
A030	Specify Function	Blue	\$190
A031	Push to Test Contact Assembly (Addition to Above)	N/A	\$275

#### Selector Switches

Part Number	Description	List Price
A041	Hand - Off - Auto Selector Switch	\$246
A042	Local - Off - Remote Selector Switch	\$246
A043	Key Operated Hand - Off - Auto Selector Switch	\$184
A044	Dual Ramps Selector Switch	\$216
A045	Two Position Selector Switch - Specify Function	\$298
A046	Three Position Selector Switch - Specify Function	\$298
A047	Other Selector Switch - Specify Function & Type	CF
A048	Test Switch (aka Test Block)	\$1,696

CF - Consult Factory

# MEDIUM VOLTAGE RVSS/ATL OPTIONS

## CONTROL OPTIONS

### Meters

Part Number	Description	List Price
A061	Single Phase Analog Ammeter w/ CT	\$1,660
A062	Analog Ammeter w/ 3 Phase Selector Switch & CTs	\$2,203
A065	Elapsed Time Meter	\$321
A066	Operations Counter	\$388
A069	Other Power Metering - Specify Function	CF
A075	Single Phase Analog Voltmeter	\$6,085
A076	Analog Voltmeter w/ 3 Phase Selector Switch	\$6,242
A077	AC Wattmeter	CF
A078	AC Watt Hour Meter	CF

### MX<sup>3</sup> Control Options

Part Number	Description	List Price
MXCOMP	Profibus Communications Bridge	\$5,686
MXCOME	Ethernet Communications Bridge	\$3,374
MXCOMD	DeviceNet Communications Bridge	\$3,108
A401	2000:1 Ground Fault CT	\$1,581
A405	Power Outage Ride Thru - This option allows the starter to automatically restart after a power loss of up to 30 secs. Customer must supply separate source of uninterrupted 120V to the starter	\$482
A411	1000VA (700W) UPS for 120V Supply instead of customer supplied for Option A405 Power Outage Ride Thru	\$4,466
A406	RTD Module - Unit will accept 8 RTD Inputs. RTDs must be 100 ohm Platinum.	\$3,830
A407	RTD Module - Unit will accept 16 RTD Inputs. RTDs must be 100 ohm Platinum.	\$6,728
A410	Emergency / Across the Line Bypass Option; Includes Start / Stop Pushbuttons, Overload Relay, Current Transformers and Selector Switch	\$2,220

### Control Power Transformers

Part Number	Description	List Price
A105	500VA Additional Control Power	\$1,787
A106	1000VA Additional Control Power	\$2,087
A107	Specify Control Power Amount	CF
A110	2000VA Additional Control Power	\$2,280

### General Purpose Control Relays

Part Number	Description	List Price
A121	Three Pole Relay - Specify Function	\$321
A122	Four Pole Relay - Specify Function	\$395
A123	Other Relay - Specify Function and Type	CF
A124	On Delay Timer - Specify Function and Time	\$395
A125	Off Delay Timer - Specify Function and Time	\$395
A126	Other Timers - Specify Function and Time	CF
A127	86 Lockout Relay	\$3,296

CF - Consult Factory

# MEDIUM VOLTAGE RVSS/ATL OPTIONS

## ENCLOSURE OPTIONS

### Enclosure Options

Part Number	Description	List Price
A171	Space Heater with Thermostat	\$945
A201	Infrared Viewing Windows (Qty. 2)	\$2,520
A203	Grounding Ball	\$1,726
A204	Service Entrance Rating	\$1,022
A252	Single Kirk Key Interlock	\$1,214
A255	Multiple Enclosure Mechanical Door Interlock	CF
A205	Cubicle Light (for MV or LV compartment)	\$4,257
A206	Touch-up Paint (ANSI 61 GRAY) 1 CONTAINER	\$250
A207	FUSE PULLER (MV)	\$1,537
A202	Empty Top Hat 18"H x 20"W x 30"D	\$4,884
A256	Enclosure Upsizing - 24"W to 36"W	\$6,000
A257	Enclosure Upsizing - 36"W to 45"W	\$5,299
A258	Enclosure Upsizing - 32"D to 36"D	\$4,200

### Enclosure Options - Tin Plated Bus

Part Number	Description	Insulation	Rating	List Price
A261A	Horizontal Bus	None	800A	\$3,956
A261B	Horizontal Bus	None	1200A	\$4,174
A261C	Horizontal Bus	None	2000A	\$5,815
A261D	Horizontal Bus	Insulated	800A	\$5,204
A261E	Horizontal Bus	Insulated	1200A	\$5,467
A261F	Horizontal Bus	Insulated	2000A	\$7,683
A262A	Bus Splice Kit	None	800A	\$360
A262B	Bus Splice Kit	None	1200A	\$885
A262C	Bus Splice Kit	None	2000A	\$1,724
A262D	Bus Splice Kit	Insulated	800A	\$950
A262E	Bus Splice Kit	Insulated	1200A	\$1,008
A262F	Bus Splice Kit	Insulated	2000A	\$1,968

### Enclosure Options - Silver Plated Bus

Part Number	Description	Insulation	Rating	List Price
A261A	Horizontal Bus	None	800A	\$6,356
A261B	Horizontal Bus	None	1200A	\$6,574
A261C	Horizontal Bus	None	2000A	\$8,215
A261D	Horizontal Bus	Insulated	800A	\$7,604
A261E	Horizontal Bus	Insulated	1200A	\$9,667
A261F	Horizontal Bus	Insulated	2000A	\$11,883
A262A	Bus Splice Kit	None	800A	\$1,560
A262B	Bus Splice Kit	None	1200A	\$2,085
A262C	Bus Splice Kit	None	2000A	\$2,924
A262D	Bus Splice Kit	Insulated	800A	\$2,150
A262E	Bus Splice Kit	Insulated	1200A	\$2,208
A262F	Bus Splice Kit	Insulated	2000A	\$3,168

# MEDIUM VOLTAGE RVSS/ATL OPTIONS

## OPTIONS

### Transducers

Part Number	Description	List Price
A141	Transducer Output 0-5VDC based on Motor FLA	\$1,107
A142	Transducer Output 04-20mA based on Motor FLA	\$1,107
A145	Transducer Output 4-20mA based on Motor Voltage	CF

CF - Consult Factory

### Power Options

Part Number	Description	List Price
A301	60KV BIL adder for RVSS (N/A for ATLS)	\$3,902
A302	Live Line Indicators (set of 3) (Up to 2 sets can be added per unit)	\$1,584

### Auxiliary Motor Starters

Part Number	Voltage				List Price
	208V	240V	480V	575V	
A151	2HP	2HP	5HP	7.5HP	\$273
A152	3HP	3HP	7.5HP	10HP	\$294
A153	-	7.5HP	10HP	15HP	\$322
A154	7.5HP	10HP	20HP	20HP	\$351

### Motor Protection Relay Accessories - does not include MPR

All kits include 3-phase CTs and a GFCT. Kits with voltage rating include a PT. "CT only"

Part Number	Voltage	Phase CTs	GFCT	List Price
A180	2400 - 4160V	Up to 400:5	50:5	\$9,171
A181	2400 - 4160V	Up to 400:5	2000:1	\$7,935
A182	N/A - CT's only	Up to 400:5	50:5	\$2,818
A183	N/A - CT's only	Up to 400:5	2000:1	\$1,581
A184	2400 - 4160V	500:5 to 800:5	50:5	\$9,570
A185	2400 - 4160V	500:5 to 800:5	2000:1	\$8,334
A186	N/A - CT's only	500:5 to 800:5	50:5	\$3,216
A187	N/A - CT's only	500:5 to 800:5	2000:1	\$1,980
A188	2400 - 4160V	≥1000:5	50:5	\$11,142
A189	2400 - 4160V	≥1000:5	2000:1	\$9,906
A190	N/A - CT's only	≥1000:5	50:5	\$4,789
A191	N/A - CT's only	≥1000:5	2000:1	\$3,352

## MEDIUM VOLTAGE RVSS/ATL OPTIONS

### SURGE/LIGHTNING ARRESTORS AND SURGE CAPACITORS

#### Surge/Lightning Arrestors

The surge or lightning arrestors are available in two options. If the unit is required to be UL approved, the surge arrestors must be installed on the top of the unit (components are shipped loose and must be installed by customer). This will add 18 inches to the height of the enclosure. For units not requiring UL approval, the arrestors may be installed inside the enclosure. This requires the enclosure width to increase to the next standard size. Hardware necessary to mount and wire the arrestors and the increased size of the enclosure where required are included.

#### Surge / Lightning Arrestors

##### Non-UL Labeled Inside Mount

Part Number	Description	List Price
A901	Surge Arrestor, 2300VAC	\$1,939
A902	Surge Arrestor, 3300VAC	\$1,939
A903	Surge Arrestor, 4160VAC	\$2,760
A904	Surge Arrestor, 4800VAC	\$2,760
A905	Surge Arrestor, 6900VAC	CF
A906	Surge Arrestor, 9000VAC	CF
A907	Surge Arrestor, 12000VAC	CF

##### UL Labeled Top Mount - 18" Height Adder (18"H x 30"W x 24"D Top Hat Shipped Loose

Part Number	Description	List Price
A925	Surge Arrestor w/Top Hat, 2300VAC	\$6,823
A926	Surge Arrestor w/Top Hat, 3300VAC	\$6,823
A927	Surge Arrestor w/Top Hat, 4160VAC	\$7,644
A928	Surge Arrestor w/Top Hat, 4800VAC	\$7,644
A929	Surge Arrestor w/Top Hat, 6900VAC	CF
A930	Surge Arrestor w/Top Hat, 9000VAC	CF
A931	Surge Arrestor w/Top Hat, 12000VAC	CF

#### Surge Capacitors

Surge capacitors will be supplied in a top hat package for starters that must maintain the UL label. This will add 18 inches to the height of the enclosure (components are shipped loose and must be installed by customer). For non-UL units, the capacitors are packaged into the unit, which increases the width of the enclosure up to the next standard size.

#### Surge Capacitors

##### Non-UL Labeled Inside Mount

Part Number	Description	List Price
A950	Surge Capacitor, 2300VAC	\$7,446
A951	Surge Capacitor, 3300VAC	\$7,446
A952	Surge Capacitor, 4160VAC	\$7,446
A953	Surge Capacitor, 4800VAC	CF
A954	Surge Capacitor, 6900VAC	CF
A955	Surge Capacitor, 9000VAC	CF
A956	Surge Capacitor, 15000VAC	CF

##### UL Labeled Top Mount - 18" Height Adder (18"H x 30"W x 24"D Top Hat Shipped Loose

Part Number	Description	List Price
A975	Surge Capacitor w/Top Hat, 2300VAC	\$12,330
A976	Surge Capacitor w/Top Hat, 3300VAC	\$12,330
A977	Surge Capacitor w/Top Hat, 4160VAC	\$12,330
A978	Surge Capacitor w/Top Hat, 4800VAC	CF
A979	Surge Capacitor w/Top Hat, 6900VAC	CF
A980	Surge Capacitor w/Top Hat, 9000VAC	CF
A981	Surge Capacitor w/Top Hat, 15000VAC	CF

CF - Consult Factory



# MEDIUM VOLTAGE RVSS/ATL OPTIONS

## LINE REACTORS

For 2.4 kV solid state starters, line reactors are not required.

For 5kV/7.2kV solid state starters, line reactors are required when the supply source transformer is greater than 20 MVA (5% impedance) or the motor lead wiring length is 1,000 feet or greater. For systems with custom motor control lineups and power factor correction capacitors, consult the factory.

For 13.8kV starters, line reactors are standard features.

The line reactors are available in two options. if the unit is required to be UL approved, the reactors must be installed on the top of the unit (reactors are shipped loose and must be installed by customer). This will add up to 24 inches to the height of the enclosure. For units not requiring UL approval, the reactors may be installed inside the enclosure. The inside mounting requires the enclosure width to increase to the next standard size to accommodate the added reactor. Hardware necessary to mount and wire the reactors and the increased size of the enclosure where required are included.

### Non-UL Labeled Inside Mount - 4160V

Part Number	Description	List Price
A985	Up to 750HP	CF
A986	751 -1500HP	CF
A987	1501-3000HP	CF
A988	3001-4000HP	CF

### UL Labeled Top Mount - 18" Height Adder (18"H x 30"W x 24"D Top Hat Shipped Loose

Part Number	Description	NEMA 12 List Price	NEMA 3R List Price
A991	Up to 750HP	CF	CF
A992	751-1500HP	CF	CF
A993	1501-3000HP	CF	CF
A994	3001-4000HP	CF	CF

CF - Consult Factory

## **DISCONNECT SWITCH SECTION OPTION**

### **Resistant Cabinet Offerings**

*Coming in 2024, Benschaw will begin offering Arc Resistant cabinets tested to IEEE C37.20.7 for products lines rated 5kV and below. The Type 2B 40kA 0.5 second offering can be ordered with either exhaust venting through either a flap or a plenum. The Type 2B 50kA 0.5 second offering is plenum exhaust venting only. For the flap option, please note that there is minimum clearance from floor to ceiling of 176.5". For the plenum option, the customer will need to supply building duct work that attaches to the plenum.*

#### **Type 2B 40kA 0.5 sec offering:**

- MLO Hinge door: 20"W x 36"D x 92.5"H
- MLO Hinge Door Extended options: 24"W x 36"D x 92.5"H
- Compact ATL: 20"W x 36"D x 92.5"H
- Standard ATL: 24"W x 36"D x 92.5"H
- Standard ATL Extended option: 30"W x 36"D x 92.5"H
- Standard Disc: 24"W x 36"D x 92.5"H
- Standard DISC extended option: 30"W x 36"D x 92.5"H
- Large Frame DISC: 36"W x 36"D x 92.5"H
- Solid State Starter: 36"W x 36"D x 92.5"H
- Solid State Starter extended option: 45"W x 36"D x 92.5"H

The plenum option will add 18" of height to the cabinet.

#### **Type 2B 50kA 0.5 sec offering:**

- MLO Hinge door: 20"W x 48"D x 100.5"H
- MLO Hinge Door Extended options: 24"W x 48"D x 100.5"H
- Compact ATL: 20"W x 48"D x 100.5"H
- Standard ATL: 24"W x 48"D x 100.5"H
- Standard ATL Extended option: 30"W x 48"D x 100.5"H
- Standard Disc: 24"W x 48"D x 100.5"H
- Standard DISC extended option: 30"W x 48"D x 100.5"H
- Large Frame DISC: 36"W x 48"D x 100.5"H
- Solid State Starter: 36"W x 48"D x 100.5"H
- Solid State Starter extended option: 45"W x 48"D x 100.5"H

**SECTION 11**

**MVH2 Series - Compact / Full Performance Drive**

- [Product Overview](#) ..... 116
- [Selection Chart & Pricing](#)..... 117
- [Technical Data](#) ..... 118
- [Drawings](#)..... 120

**M2L Series - High End Drive**

- [Product Overview](#) ..... 122
- [Technical Data](#) ..... 123
- [Performance](#) ..... 124
- [Flexibility of Installation](#)..... 125
- [Total Cost of Ownership](#)..... 126
- [Application](#) ..... 127
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**Specialty Applications**

- [Synchronous Transfer](#)..... 130
- [Synchronous Transfer Application](#) ..... 130

# MVH2 - SERIES

## COMPACT/FULL PERFORMANCE MV VFD

*Benshaw MVH2 Series Medium Voltage VFDs utilize H-Bridge multi-level and overlapping wave technology for low harmonic content and a nearly perfect sine wave output. Full-size performance ... in a compact design!*

*The latest in phase-locked loop technology is used to adjust drive output ... providing an ideal solution for soft start, speed control, energy savings and intelligent control of any MV induction or synchronous motor.*

*Offering the performance of a full-size standard drive in a small footprint layout, MVH2 Series drives are ideal for retrofit projects or any installation with space constraints.*



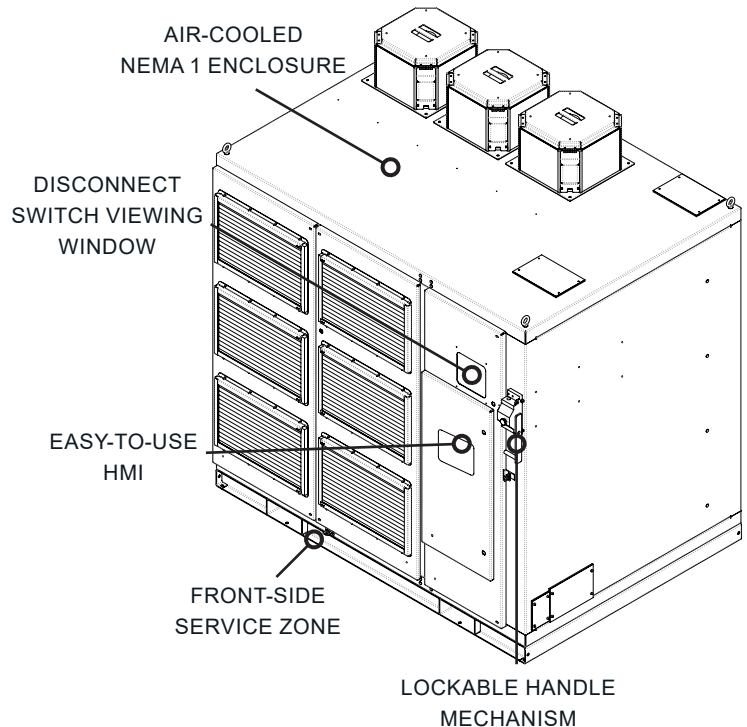
- UL Listed to 1200HP @ 4160V (up to 154A)
- NEMA 1 forced air, front access, welded enclosure
- Fully integrated, packaged VFD: Load break fused disconnect; Inline contactor; built in dry type transformer
- Door-mounted touch screen HMI
- IEEE 519 compliant, 24 pulse design
- V/Hz, open or closed loop, vector control
- No cable length restrictions
- Standalone or integrated into an MCC (optional)
- Synchronous Transfer up to 4 motors (optional)

### KEY FEATURES

- Fully integrated, packaged drive
- 50 KAIC short circuit fault rating
- 60kV BIL
- 400 A load break, 5kV rated disconnect switch, mechanically interlocked
- Standalone or integrated into an MCC
- Top or bottom entrance for both incoming and outgoing power
- Voltage source multi-cell inverter
- Modbus RTU standard, DeviceNet, Profibus, Ethernet optional
- Class H dry type transformer (Al windings) with embedded RTDs

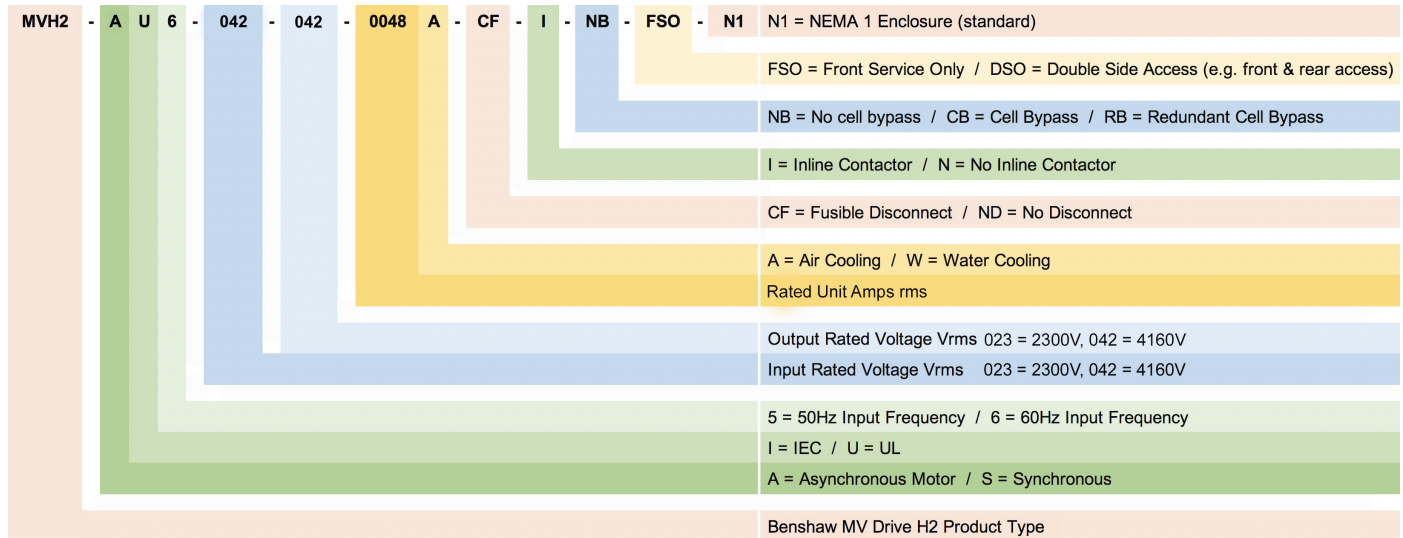
### COMMON APPLICATIONS

- Pumps
- Blowers
- Fans
- Compressors
- Chillers
- Test stands
- Kiln drives
- Conveyors



# MVH2 - SERIES

## PART NUMBER ASSEMBLER



## PRICING

### 2300 V

Model Number	Voltage	Approx Max HP*	FLA	Dimensions (in.)**			List Price
				H	W	D	
MVH2-AU6-023-023-0077A-CFI-NB-FSO-N1	2300	300	77	91.5	86	60	\$278,092
MVH2-AU6-023-023-0154A-CFI-NB-FSO-N1	2300	600	154	91.5	86	60	\$297,191

### 4160 V

Model Number	Voltage	Approx Max HP	FLA	Dimensions (in.)**			List Price
				H	W	D	
MVH2-AU6-042-042-0031A-CFI-NB-FSO-N1	4160	200	31	91.5	86	60	\$265,689
MVH2-AU6-042-042-0040A-CFI-NB-FSO-N1	4160	300	40	91.5	86	60	\$267,911
MVH2-AU6-042-042-0048A-CFI-NB-FSO-N1	4160	350	48	91.5	86	60	\$271,244
MVH2-AU6-042-042-0061A-CFI-NB-FSO-N1	4160	450	61	91.5	86	60	\$274,578
MVH2-AU6-042-042-0077A-CFI-NB-FSO-N1	4160	600	77	91.5	86	60	\$278,092
MVH2-AU6-042-042-0096A-CFI-NB-FSO-N1	4160	700	96	91.5	86	60	\$284,969
MVH2-AU6-042-042-0104A-CFI-NB-FSO-N1	4160	800	104	91.5	86	60	\$288,302
MVH2-AU6-042-042-0115A-CFI-NB-FSO-N1	4160	850	115	91.5	86	60	\$291,858
MVH2-AU6-042-042-0130A-CFI-NB-FSO-N1	4160	1000	130	91.5	86	60	\$294,969
MVH2-AU6-042-042-0154A-CFI-NB-FSO-N1	4160	1200	154	91.5	86	60	\$297,191

Note: 4160V models UL listed. UL testing of 2300V units TBD.

\* Approx. Max HP based on a 4-pole motor. Size according to actual motor FLA.

\*\* Overall dimensions. Height includes fans.

## MVH2 - SERIES

### TECHNICAL DATA

Feature	Specification/Rating	
Main Power Supply	Voltage	2300 or 4160V (+5%, -20% with output power derating)
	Frequency	50 or 60Hz (+/- 10%)
	Phase Unbalance	Less than 5%
	True Power Factor	>0.96
Control Power Supply	Voltage	230V single phase
	Frequency	50 or 60Hz
Enclosure	Standard	NEMA 1
Control	Control Type	Sinusoidal multilevel PWM
		Fully digital
	Control Mode	Open and closed loop V/F and vector control
	Switching Mode	Multilevel IGBT
	Frequency Mode	0 ... 80HZ
	Overload Capacity	150% instantaneous
		120% for 120 seconds, every 15 minutes
Efficiency	≥ 96%	
Performance	Speed Control	0.1% closed loop, 0.5% open loop
		Resolution: 1 RPM
Control Inputs	Analog	2 x Programmable isolated input: 4-20mA, 2-10V
		1 x Excitation feedback 4-20mA, 2 -10V
	Digital	14 Isolated inputs: 24Vdc
Control Outputs	Analog	2 Fixed outputs: 4-20mA / 2-10V
		2 Programmable outputs: 4-20mA / 2-10V
	Relay	22 Isolated outputs with dry contacts
Communication	Fieldbus Communication	Standard Modbus RTU
		DeviceNet / Profibus / Ethernet IP (optional)
Power Cell Bypass Function (86A and below)	Allows for continued operation with 1 or 2 failed cells	
	Failed cells are bypassed automatically without interruption of equipment process	
	Failed cells can be replaced quickly due to draw-out construction of power cell	
	High productivity and low mean time to repair (MTTR)	

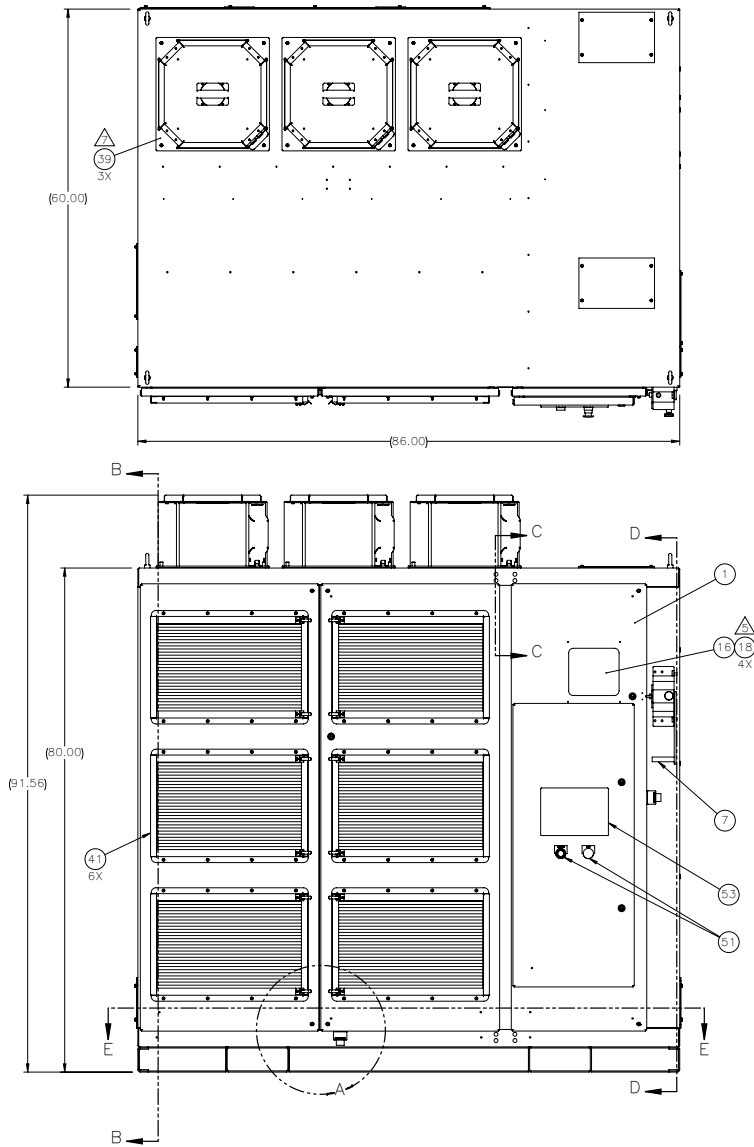
Future options: Cell bypass above 86A, horizontal bus, NEMA 3R

# MVH2 - SERIES

## TECHNICAL DATA

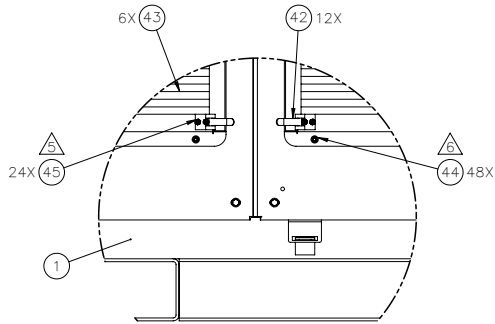
Feature		Specification/Rating
Safety	Protections (Storage of last 100 faults/ alarms with date and time)	DC Link overvoltage
		Drive and transformer overtemperature
		Output overcurrent
		Motor overload
		Output short circuit
		Output ground fault
		Internal fault
		External fault
		Serial communication fault
		Power supply phase loss
		Overvoltage
		Undervoltage
		Over speed
Ambient	Temperature	23°F ... 104°F (-5°C ... -40°C)
	Humidity	< 95% non-condensing
	Altitude	0 ... 5000 ft (above 3300 ft - 1% derating for every additional 330 ft)
Finishing	Color	ANSI 61 Gray
		Special paint color optional
Conformities Standards	Electromagnetic Compatibility	IEEE 519-2014
		IEC 61800-3
		UL/cUL (up to 154A)
Flying Start	Starting into spinning motor	
High Performance	Vector control, open & closed loop for superior dynamic speed accuracy & torque control	
Motor and System Protections	Motor Overload	Overvoltage
	Overcurrent	Current limit
	Phase loss	Over temperature
	Ground fault	Cabinet door interlock (optional)
Standards and Approvals	IEC 60038	IEC 61000
	IEC 60050-151, -551	IEC 61800-3
	IEC 60076	IEC 60757
	IEC 60721, relevant chapters	IEC 106
	UL 347A	UL 508A

# MVH2 SERIES - DRAWINGS

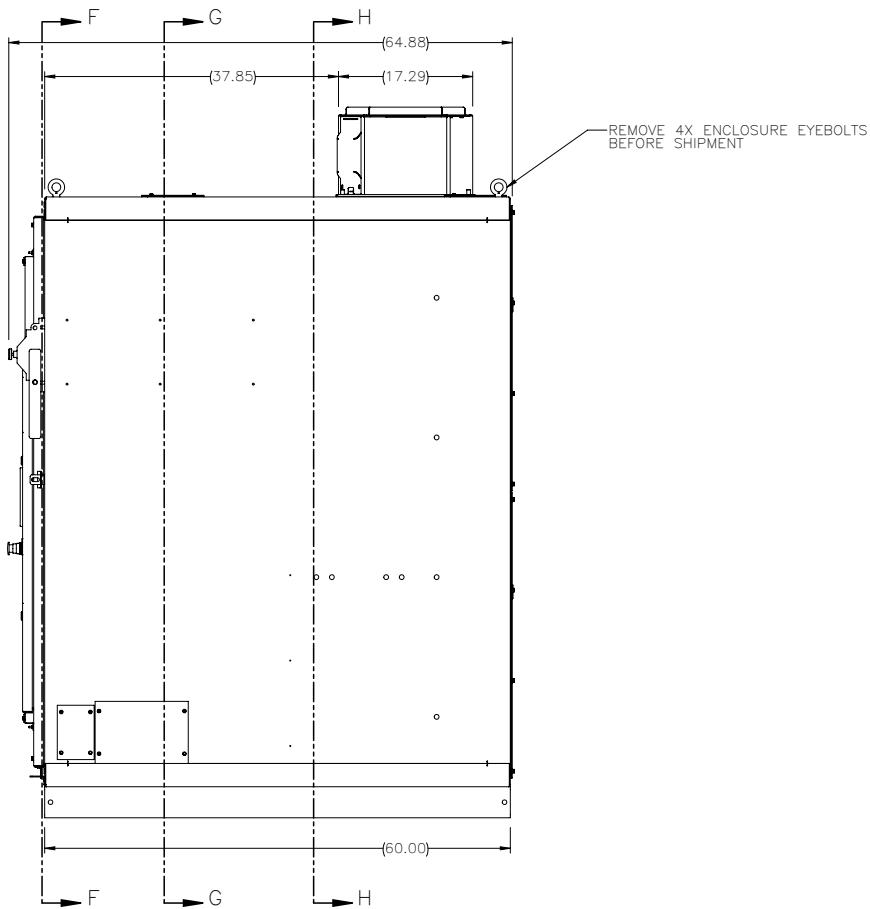
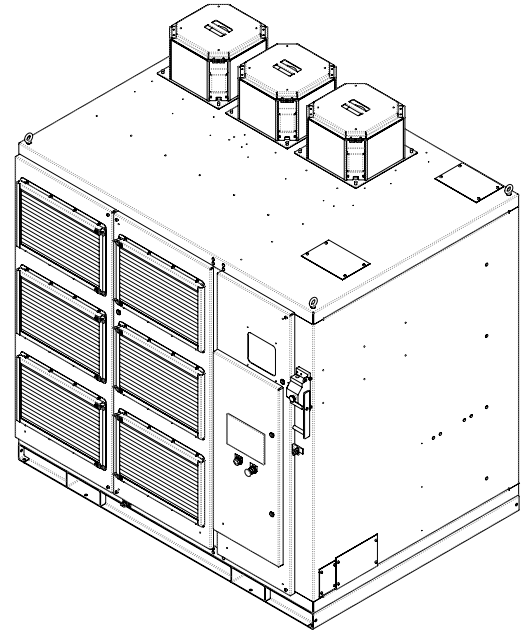




# MVH2 SERIES - DRAWINGS



DETAIL A  
SCALE 1 : 5



## M2L SERIES

### HIGH-END MV VFD

*Our M2L Medium Voltage Variable Frequency Drive family provides the utmost in performance, reliability, serviceability and safety. The M2L Series is designed for versatility, with numerous installation configurations available to suit environmental conditions, providing significant cost savings and reduced total cost of ownership.*

Benshaw M2L Medium Voltage Variable Frequency Drives feature a unique, patented topology, with independent transformer, rectifier and inverter sections, allowing Benshaw to offer flexible packaging options to accommodate a wide range of project-specific requirements and limitations.

Benshaw's modular, power-cell-based M2L inverters use the most reliable components available ... such as low voltage IGBT and dry-type film capacitors ... and they are equipped with the latest in safety features, including a fast and reliable arc flash detection system. This topology, along with the M2L's advanced remote monitoring system, helps minimize down-time and simplify integration with other drive system components.

The M2L Medium Voltage Variable Frequency Drive family spans a power range from 300 HP to 12,000 HP, operating at industry-standard medium voltages up to 7.2kV and accepting up to 35kV input. Redundant fans are included in the standard design.

Benshaw offers all the isolation disconnects, contactors, synchronous reactor, synchronous controller, and motor protection relays, in multiple options and configurations for up to ten (10) motors.

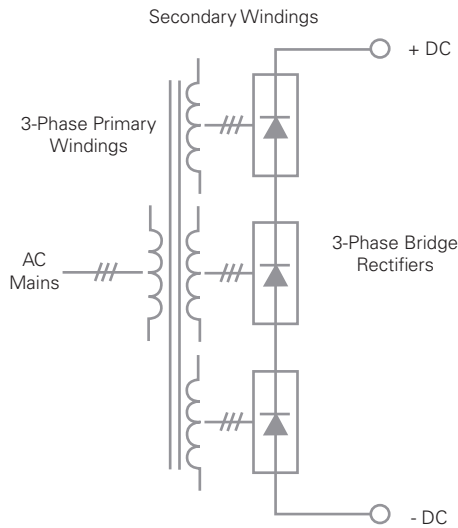


- Patented topology
- Flexibility of installation
- Industry-leading performance
- Enhanced reliability and efficiency
- Reduced cost of ownership
- Simplified serviceability
- Dependable safety
- Synchronous Transfer option (up to 10 motors)

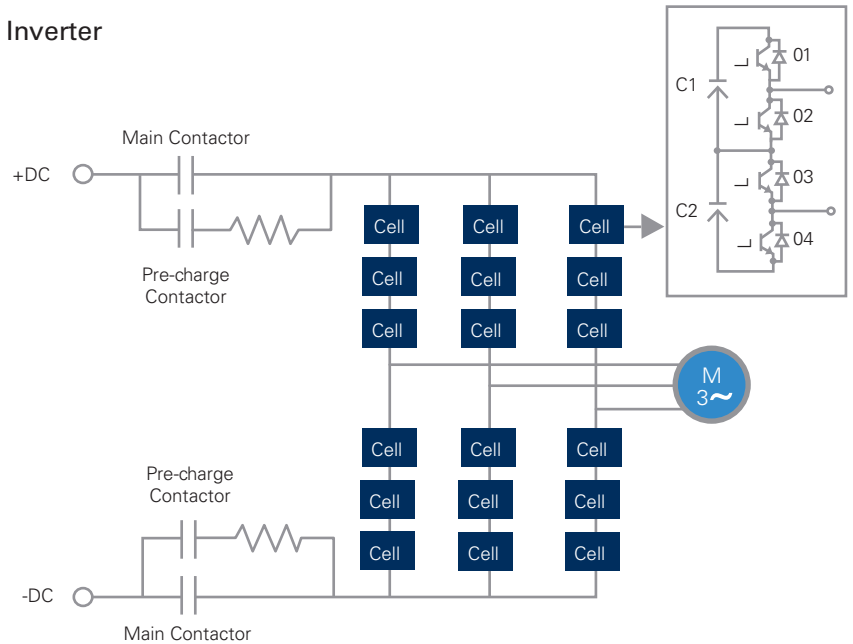
# M2L SERIES

## TECHNICAL DATA

### Transformer/Rectifier



### Inverter



### INPUT LINE SPECIFICATION

- Input Voltage<sup>1</sup>
  - 3Ø, 380 V–35 kV ±10%
- Input Frequency
  - 50 or 60 Hz ±5%

### MOTOR-SIDE SPECIFICATION

- Output Voltage<sup>1</sup>
  - 3Ø, 0–2300 V
  - 3Ø, 0–4160 V
  - 3Ø, 0–7200 V
- Output Current
  - 0–770 A Single Inverter
  - 0–1500 A Parallel Inverters
- Output Frequency<sup>2</sup>
  - 0–90 Hz
- Output Power<sup>3</sup>
  - Up to 12,000 HP

### INPUT TRANSFORMER

- 6–36-Pulse
- Air-cooled or Oil-filled
- Indoor or Outdoor Installation

### RECTIFIER

- 6–36-Pulse
- Diode Front End
- Indoor or Outdoor Installation

### INVERTER

- Multi-Level PWM
- LV IGBT Power Cells
- Indoor Installation

### CONTROL METHODS

- Volts/Hertz (V/Hz)
- Sensorless Vector Control (SVC)

### EFFICIENCY

- Inverter
  - >99.5%
- Drive System
  - >97%

<sup>1</sup> Consult factory for voltages other than specified ranges.

<sup>2</sup> Consult factory for higher output frequency requirements.

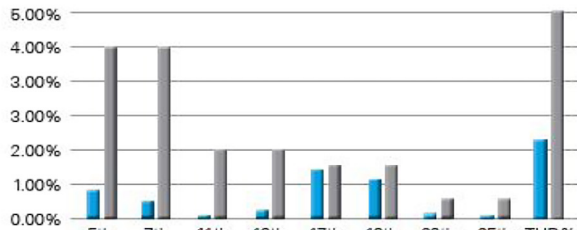
<sup>3</sup> Consult factory for higher power requirements.

# M2L SERIES

## PERFORMANCE

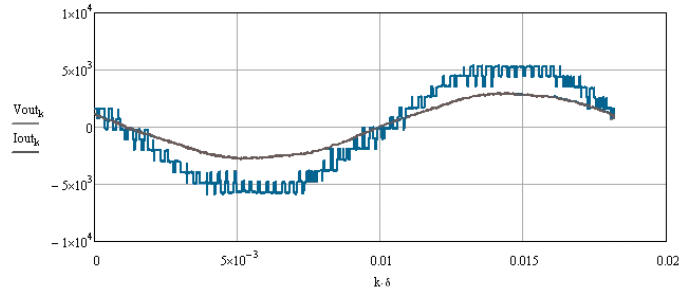
### SUPERIOR UTILITY-FRIENDLY INPUT POWER QUALITY

Example of Input Current Harmonic Spectrum



- Input currents and voltages meet/exceed IEEE 519 requirements
- Input PF > 0.95
- Input filter not required

### SUPERIOR MOTOR-FRIENDLY OUTPUT WAVEFORM QUALITY



- Motor-friendly 13-level line-to-line output voltage
- Low harmonics and low dV/dT
- Output filter not required (cables up to 1000 ft.)



### RELIABILITY

Availability of operations is ensured through simple and well-proven design. Utilizing simple and standard transformer and rectifier minimizes the component count as well as cable connections. True power-cell- based inverter design creates the most modular inverter design in industry while enabling use of highly reliable components such as dry-type film capacitors and LV IGBTs. Redundant fans are included in the standard design.

### SAFETY

Workforce, application and equipment are protected through safe design with reduced arc flash footprint and unique and standard arc flash detection system. Remote HMI allows personnel to operate the drive while away from medium voltage.

### SERVICEABILITY

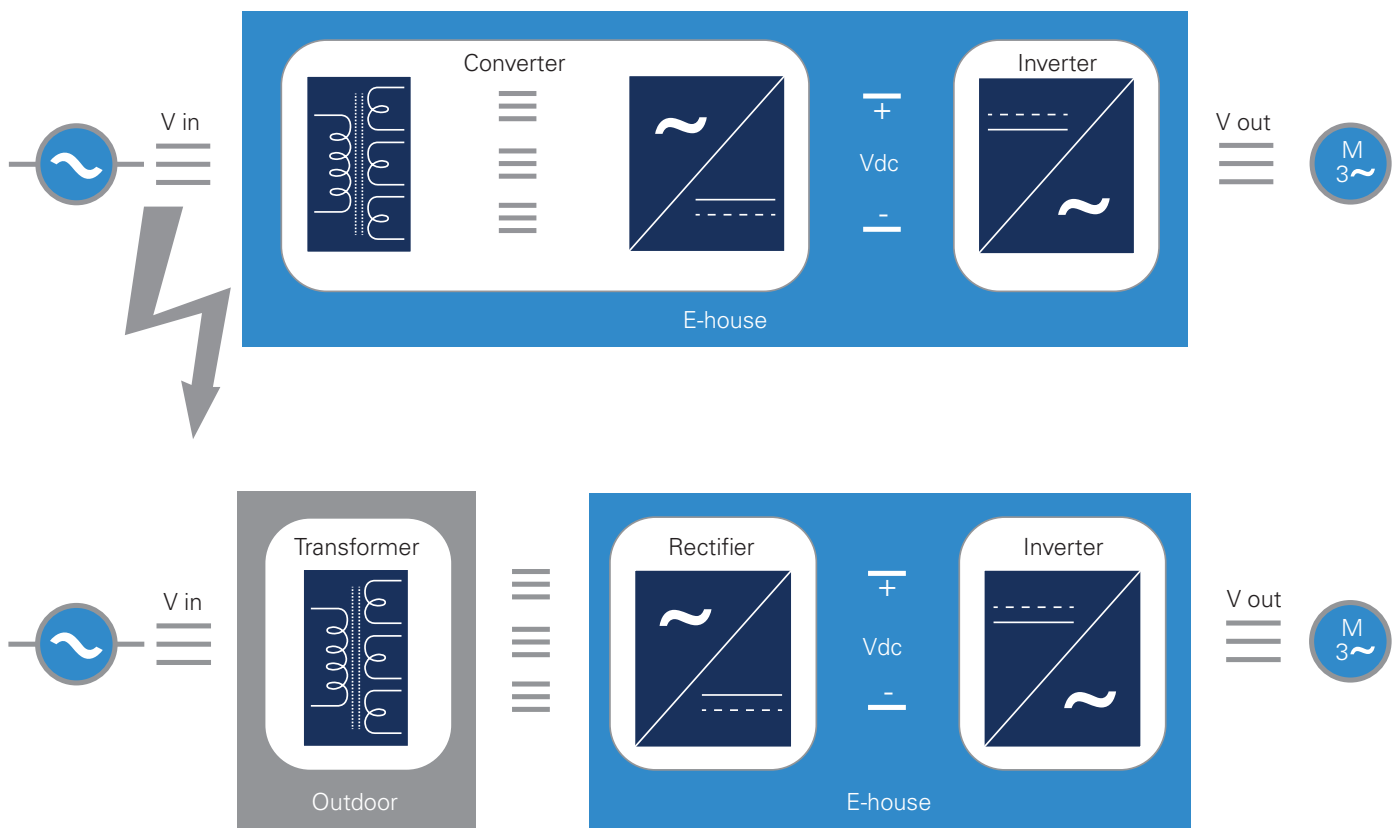
Simple and fast maintenance is ensured through front access only design and advanced diagnostic tools such as Benschaw Connect. Benschaw Connect provides intuitive, user-friendly access to operational and conditional data, trends and events log as well as control and motor parameters.

# M2L SERIES

## FLEXIBILITY OF INSTALLATION

### FLEXIBILITY OF INSTALLATION

Great versatility provides various configuration and installation options to make the solution suitable for operation in different environmental conditions while providing significant cost savings and reduced total cost of ownership.



# M2L SERIES

## TOTAL COST OF OWNERSHIP

### SIGNIFICANT SAVING ON YOUR AIR-CONDITIONING COST

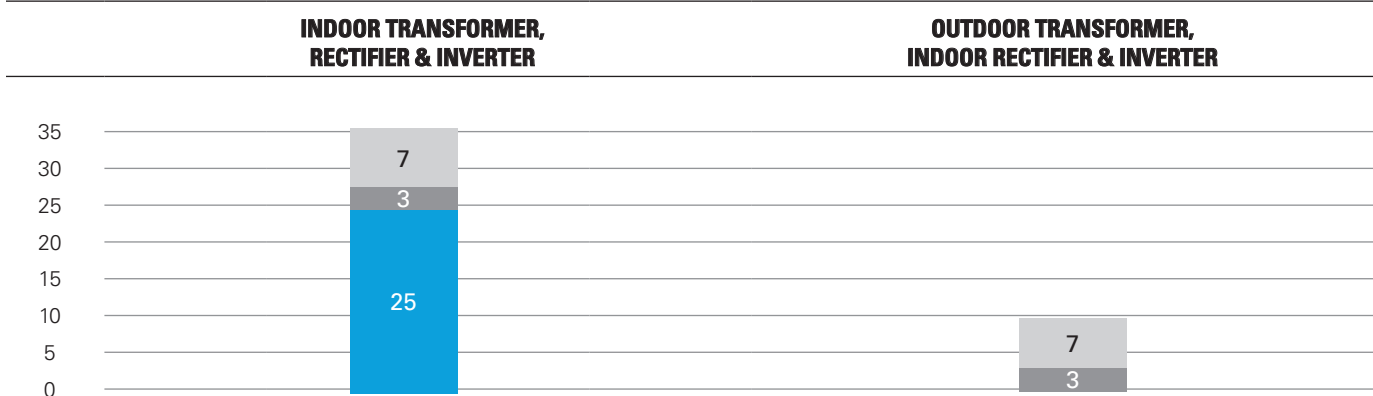
Significant savings on initial investment, operating cost and maintenance costs of air-conditioning system by moving majority of heat load outdoors.

### HEAT LOAD ANALYSIS

Example shown for a typical 5000 HP MV drive with 97% overall efficiency

Power Loss and Heat Load		
	POWER LOSS (kW)	HEAT LOAD (BTU/HR)
Transformer	80	275,000
Rectifier	10	34,000
Inverter	25	85,000
Drive	115	394,000

### Required Air-Conditioning Tonnage to Dissipate Heat from E-House



Yearly Operating Cost	\$37,000	\$11,000
20-Year Operating Cost	\$788,000	\$225,000

<sup>1</sup>Calculations above do not include redundant HVAC capacity and installation and maintenance cost of HVAC units.

# M2L SERIES

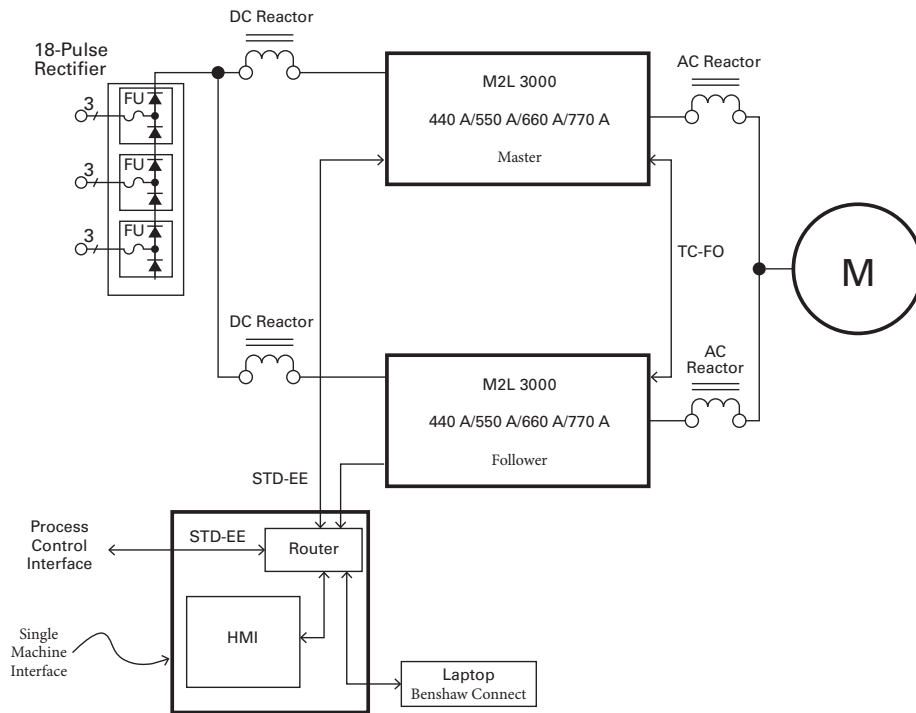
## APPLICATION

### PARALLEL DRIVE

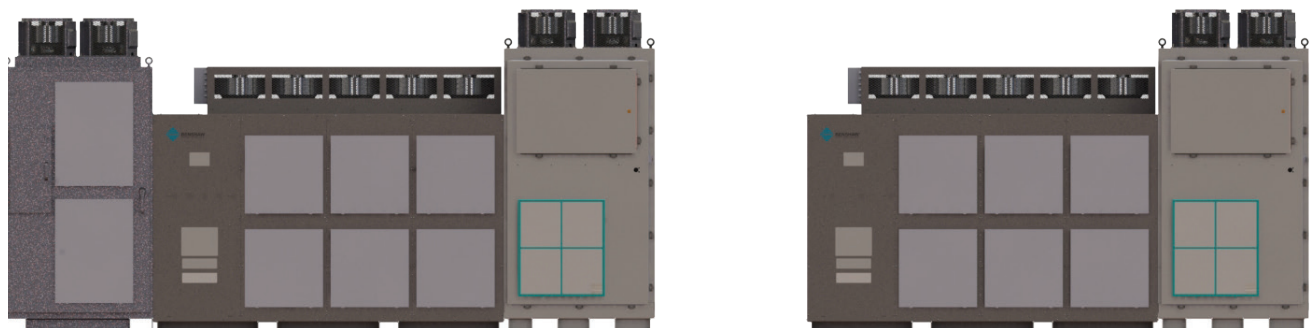
The modular and flexible design of the M2L MV drive provides the ability to utilize two inverters in parallel and expand the HP rating of a fully air-cooled solution to beyond 10,000 HP range. An air-cooled solution at this HP range eliminates cumbersome piping and complex and unreliable liquid-cooling systems, thus offering significant cost savings during initial investment, installation and operation of the drive.

The 2ML design utilizes modular building blocks; therefore, the same components are used to achieve higher horsepower ratings. Using modular building blocks allows the customer to standardize on lower-cost spare parts, minimizing downtime and maintenance costs.

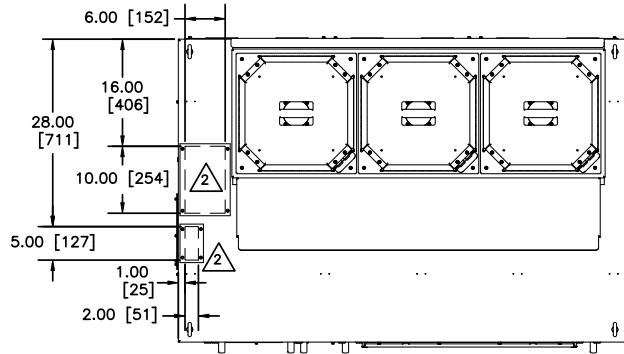
One-Line Diagram with Parallel Drive and Outdoor Transformer



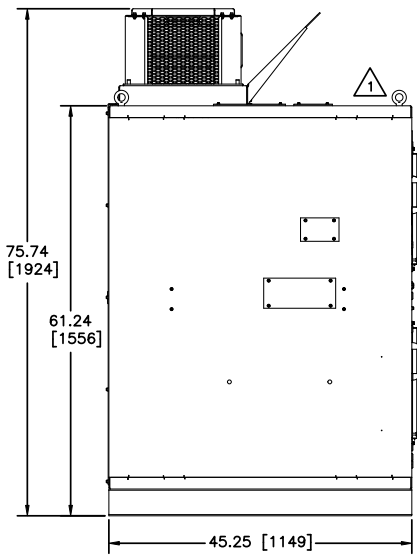
Line-Up for 8000 HP 4160 V Parallel Drive with Outdoor Transformer



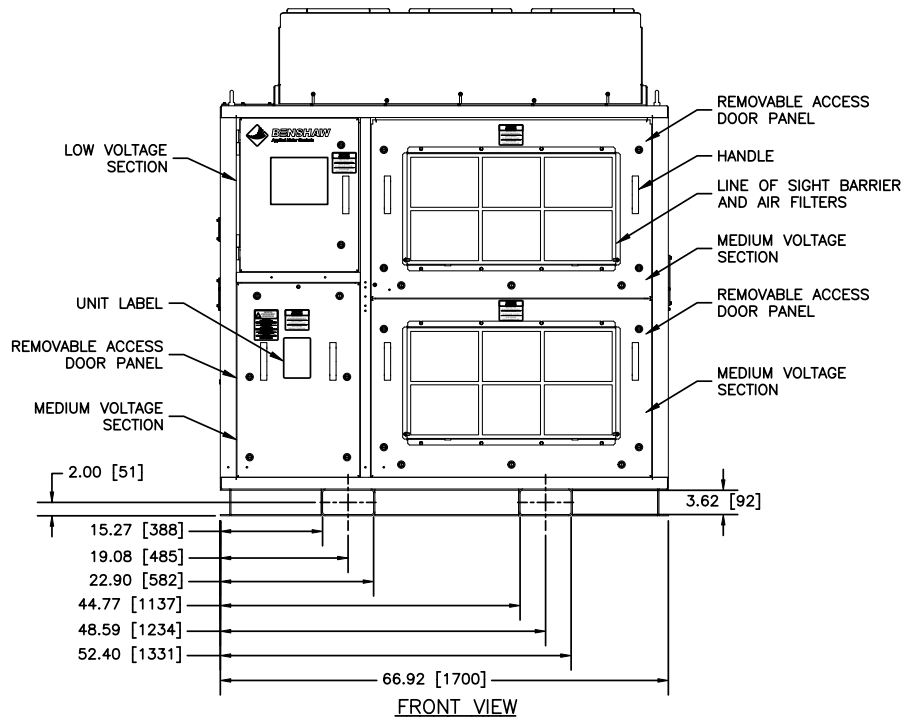
# M2L SERIES - DRAWINGS



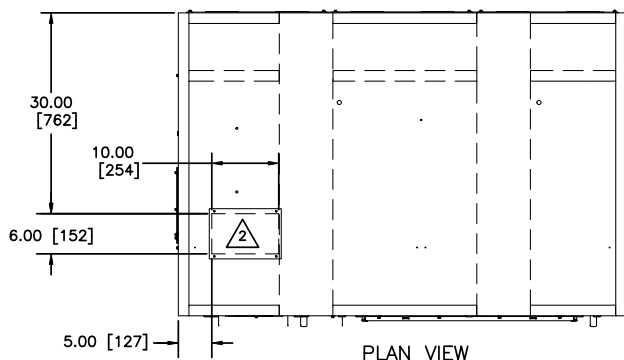
TOP VIEW



LEFT VIEW



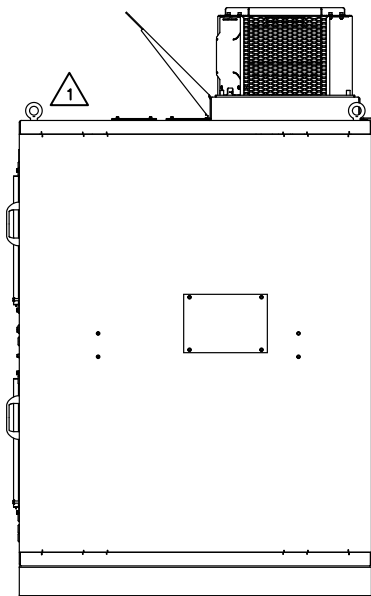
FRONT VIEW



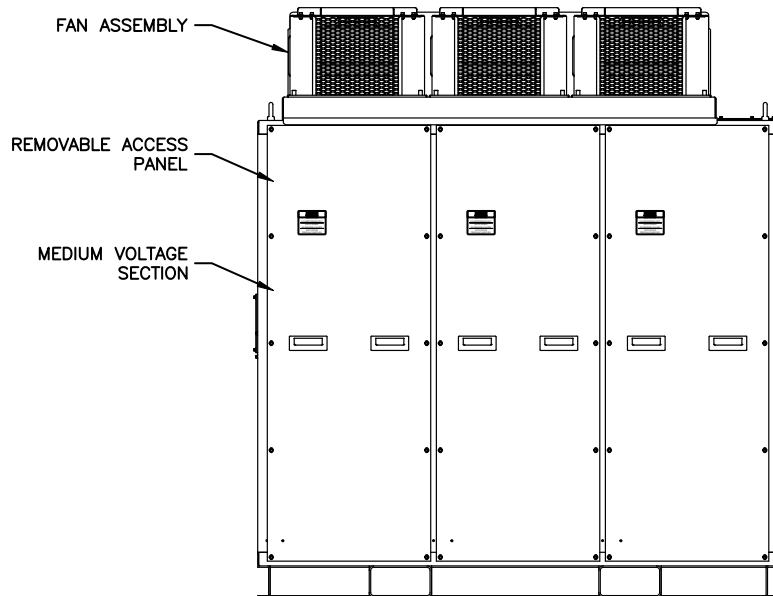
PLAN VIEW



# M2L SERIES - DRAWINGS



RIGHT VIEW



REAR VIEW

NOTES:

- 1 REMOVABLE LIFTING EYEBOLTS
- 2 CABLE ENTRY/EXIT AREA. CUTOUT AND COVERPLATE SUPPLIED.
- 3. ENCLOSURE COLOR: ANSI 61 GREY
- 4. TIGHTEN BOLTS PER CHART BELOW

STEEL BOLT TORQUE IN POUND-FOOT [NEWTON-METER]				
1/4-20	5/16-18	3/8-16	1/2-13	5/8-11
5 [6.8]	12 [16.3]	20 [27]	50 [67.8]	95 [128.8]

- 5. APPROXIMATE WEIGHT 4500LBS.

# SPECIALTY APPLICATIONS

## SYNCHRONOUS TRANSFER

The Synchronous Transfer option allows the VFD motor output voltage and phasing to synchronize to that of the incoming utility supply, thus allowing the motor to be directly connected to the incoming line. This synchronization and transfer operates in a 'bump-less' manner for both VFD to Line, and Line back to VFD connection. This 'bump-less' transfer eliminates current and torque surges to the line, motor, and load system.

Benshaw offers all the isolation disconnects, contactors, synchronous reactor, synchronous controller, and motor protection relays, in multiple options and configurations for up to four (4) motors for the MVH2 series, and up to ten (10) motors for the M2L series drives, providing an easy, fast, and smooth one-stop shop experience.

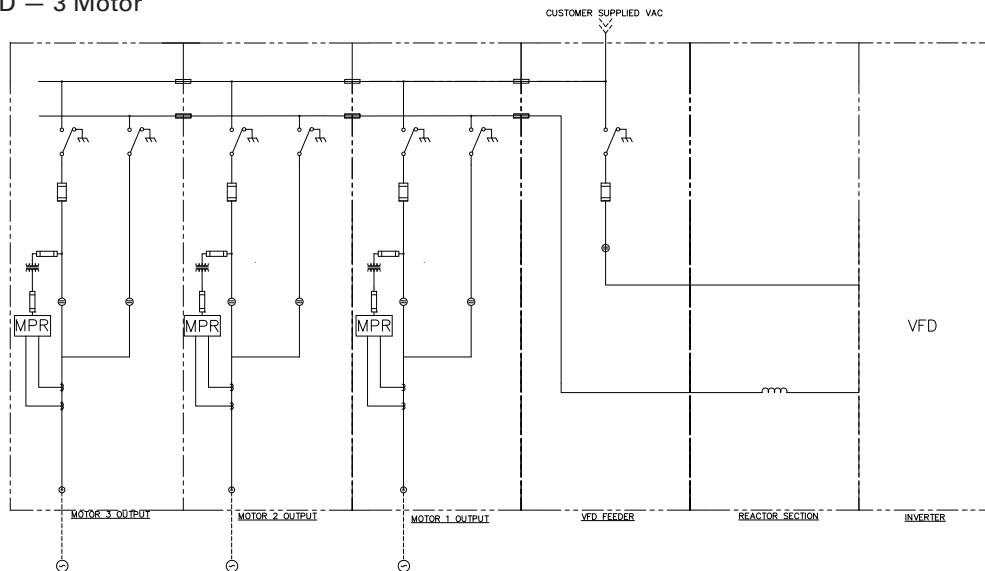
## SYNCHRONOUS TRANSFER APPLICATION

**Single VFD with Single Motor** - Single motor setup provides the ability to soft start a motor and load combination which eliminates any inrush current thus reducing the impact on weak power systems. The motor may be operated at variable speeds using the VFD or transferred across the line to operate at full speed.

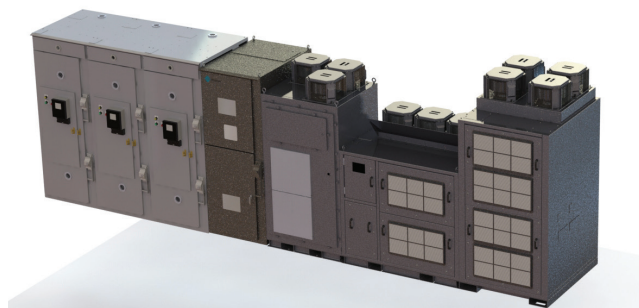
This configuration also gives the opportunity for 'Starting Duty Only' operation; where a higher FLA motor than the VFD current rating can be started unloaded (so long as the unloaded motor current is within the VFD range), transferred to the utility line, then fully loaded. This eliminates line disturbances usually associated with starting a higher HP motor conventionally and can potentially reduce VFD size.

**Single VFD with Multiple Motors** - This provides the same benefits as the single motor configuration above, but with multiple motors. Multiple motors may be transferred and maintained line transferred, in any order, each with independent motor protection, while one motor remains on VFD control for load trimming purposes.

One-Line Diagram 1 VFD — 3 Motor



Line-Up Diagram 1 VFD — 3 Motor



**SECTION 12**

**Medium Voltage Drive Feeder**

Drive Feeder Non-Bypassed ..... 132

Drive Feeder with ATL Bypass..... 134

Drive Feeder with Fully Isolated ATL Bypass..... 136

# MEDIUM VOLTAGE DRIVE FEEDER

## DRIVE FEEDER NON-BYPASSED

Shunt isolation is required in order to protect the VFD from line power in the case of the fault. Load-break isolation is required to be able to safely perform maintenance on drive solutions. Benshaw provides standard solutions for isolation drive systems utilizing load-break disconnect switches and contactors. The Benshaw drive solutions are designed to seamlessly integrate into existing Benshaw medium voltage line-ups.

### VFD FEEDER

The VFD Feeder provides input isolation to the VFD, but does not allow for bypass. The contactor will open, isolating the VFD, should a fault appear.

Each VFD Feeder includes the following:

- 5 kV vacuum contactor
- 4.76 kV disconnect
  - Load break/fault make
  - Grounding bar
  - Viewing window
- Class E rated fuses
- NEMA 12 enclosure

Model Number	Voltage	Approximate maximum HP (kW)	FLA	Dimensions (in.)			Disconnect Rating	Disconnect Type
				H	W	D		
CFMVM2LDISC-160A-2300-12	2300	700 (500)	160 and below	92.5	24	36	400 A load break and 600 A continuous	Rotary handle
CFMVM2LDISC-160A-4160-12	4160	1300 (950)	160 and below	92.5	24	36	400 A load break and 600 A continuous	Rotary handle

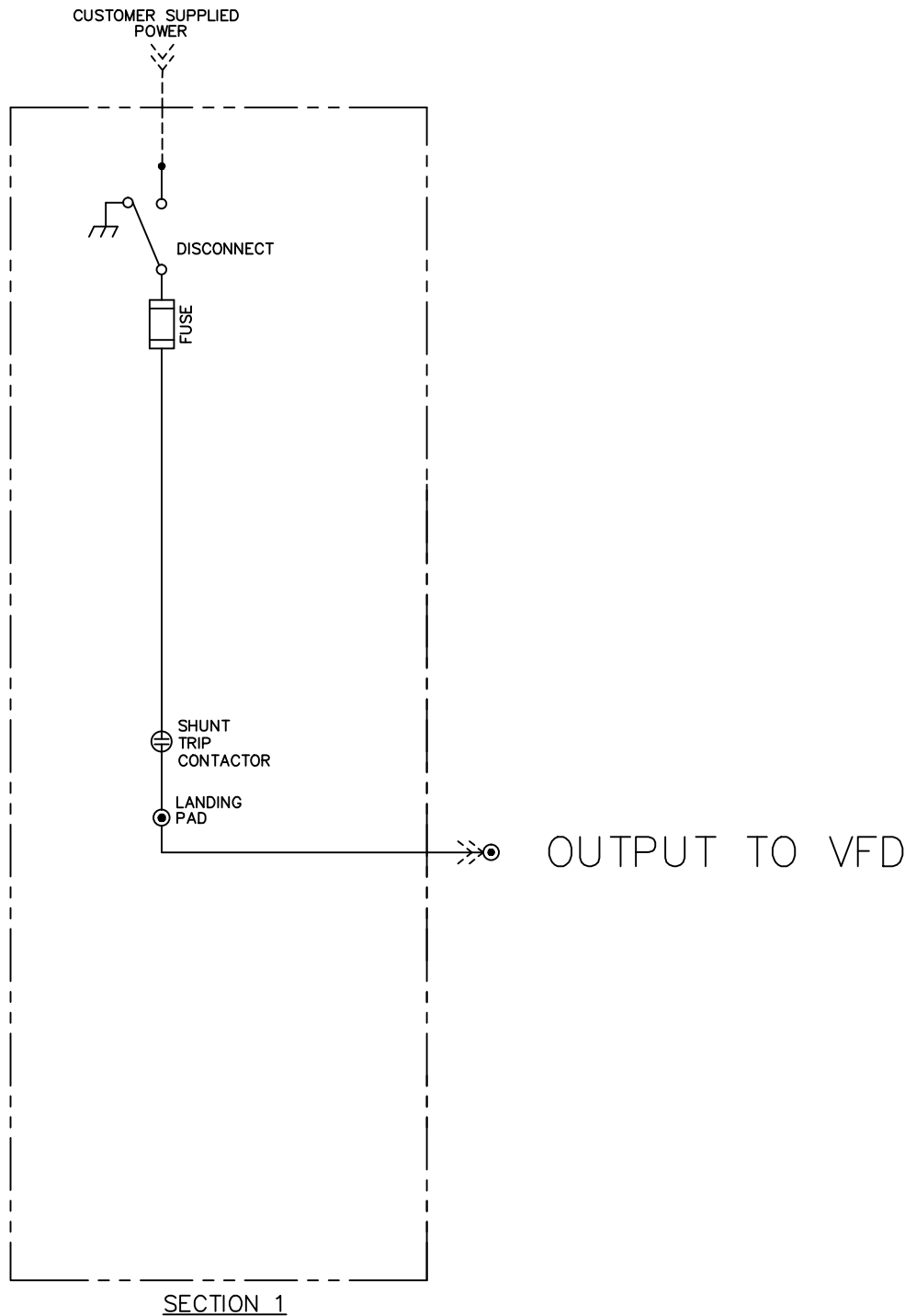
\*The FLA of the system must include any safety factor of the motor, and should be sized to the maximum full load current at which the motor will operate.

\*All dimensions above assume top entry and a pass-through exit to the neighboring converter or bottom exit. Contact Benshaw for additional entry/exit options.

\*Consult factory for larger sizes or alternate enclosure ratings.

# MEDIUM VOLTAGE DRIVE FEEDER

## DRIVE FEEDER NON-BYPASSED



# MEDIUM VOLTAGE DRIVE FEEDER

## DRIVE FEEDER WITH ATL BYPASS

### VFD FEEDER WITH ATL BYPASS

Having the option for ATL bypass allows for operation of the motor if the drive fails. Power is applied through the closure of a vacuum contactor and disconnect switch, bypassing the VFD, and connecting the motor directly to the line. This solution is highly recommended for critical applications that can't afford any downtime.

Each VFD Feeder with ATL Bypass includes the following:

#### ATL STARTER SECTION

- 4.76 kV disconnect
  - Load break/fault make
  - Grounding bar
  - Viewing window
- Class R rated fuses
- (2) 5 kV vacuum contactors — one for line isolation and one for VFD output isolation
- NEMA 12 enclosure
- MX<sup>3</sup> protection
  - (3) phase current transformers
  - MV divider card
  - MX<sup>3</sup> keypad
  - MX<sup>3</sup> control board

#### MAIN VFD DISCONNECT

- 4.76 kV disconnect
  - Load break/fault make
  - Grounding bar
  - Viewing window
- Class E rated fuses
- 5 kV VFD input vacuum contactor
- NEMA 12 enclosure

Model Number	Voltage	Approximate maximum HP (kW)	FLA	Dimensions (in.)			Disconnect Rating	Disconnect Type
				H	W	D		
CFMVM2LBYP-160A-2300-12	2300	700 (500)	160 and below	92.5	60	36	400 A load break and 600 A continuous	Rotary handle
CFMVM2LBYP-160A-4160-12	4160	1300 (950)	160 and below	92.5	60	36	400 A load break and 600 A continuous	Rotary handle

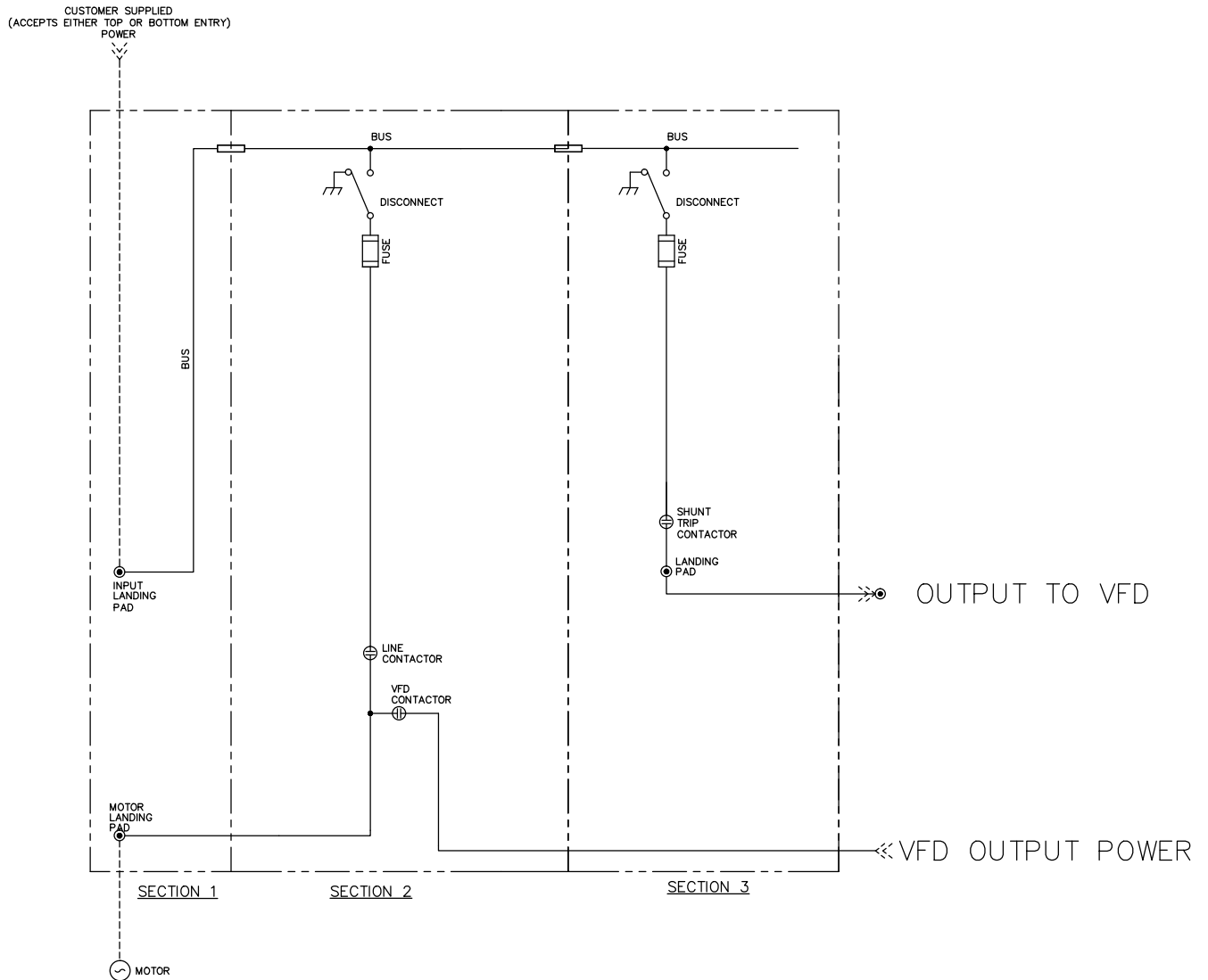
\*The FLA of the system must include any safety factor of the motor, and should be sized to the maximum full load current at which the motor will operate.

\*All dimensions above assume top entry and a pass-through exit to the neighboring converter or bottom exit. Contact Benschaw for additional entry/exit options.

\*Consult factory for larger sizes or alternate enclosure ratings.

# MEDIUM VOLTAGE DRIVE FEEDER

## DRIVE FEEDER WITH ATL BYPASS



Note that to run in ATL mode, the ATL disconnect must be closed and the VFD disconnect must be opened.

\*With the standard configuration, two load side connection points are required — one to the ATL Starter Section and one to the Main VFD Disconnect Section. This option includes the following in order have only one load power connection point for CFMVM2LBYP-160A-2300/4160-12.

- NEMA 12 Enclosure approx. 92.5"H x 18"W x 36"D
- Motor Landing Pad
- 800 A Non-insulated Bus

# MEDIUM VOLTAGE DRIVE FEEDER

## DRIVE FEEDER WITH FULLY ISOLATED ATL BYPASS

### VFD FEEDER WITH FULLY ISOLATED ATL BYPASS

To continuously run a motor even during servicing of the medium voltage drive, an additional disconnect switch is required. This solution allows the motor to run through the bypass starter while the drive can be safely worked on. This is recommended for highly critical applications where no downtime can be tolerated.

Each VFD Feeder with Fully Isolated ATL Bypass includes the following:

#### (2) HIGH ATL STARTER/VFD OUTPUT ISOLATION SECTIONS

- (2) 4.76 kV disconnects — one for line isolation and one for VFD output isolation
  - Load break/fault make
  - Grounding bar
  - Viewing window
- Class R rated fuses
- (2) 5 kV vacuum contactors — one for line isolation and one for VFD output isolation
- NEMA 12 enclosure
- MX<sup>3</sup> protection
  - (3) phase current transformers
  - MV divider card
  - MX<sup>3</sup> keypad

#### MAIN VFD DISCONNECT

- 4.76 kV disconnect
  - Load break/fault make
  - Grounding bar
  - Viewing window
- Class E rated fuses
- 5 kV VFD input vacuum contactor
- NEMA 12 enclosure

Model Number	Voltage	Approximate maximum HP (kW)	FLA	Dimensions (in.)			Disconnect Rating	Disconnect Type
				H	W	D		
CFMVM2LFBYP-160A-2300-12	2300	700 (500)	160 and below	92.5	60	36	400 A load break and 600 A continuous	Rotary or Flange Handle
CFMVM2LFBYP-160A-4160-12	4160	1300 (950)	160 and below	92.5	60	36	400 A load break and 600 A continuous	Rotary or Flange Handle

\*The FLA of the system must include any safety factor of the motor, and should be sized to the maximum full load current at which the motor will operate.

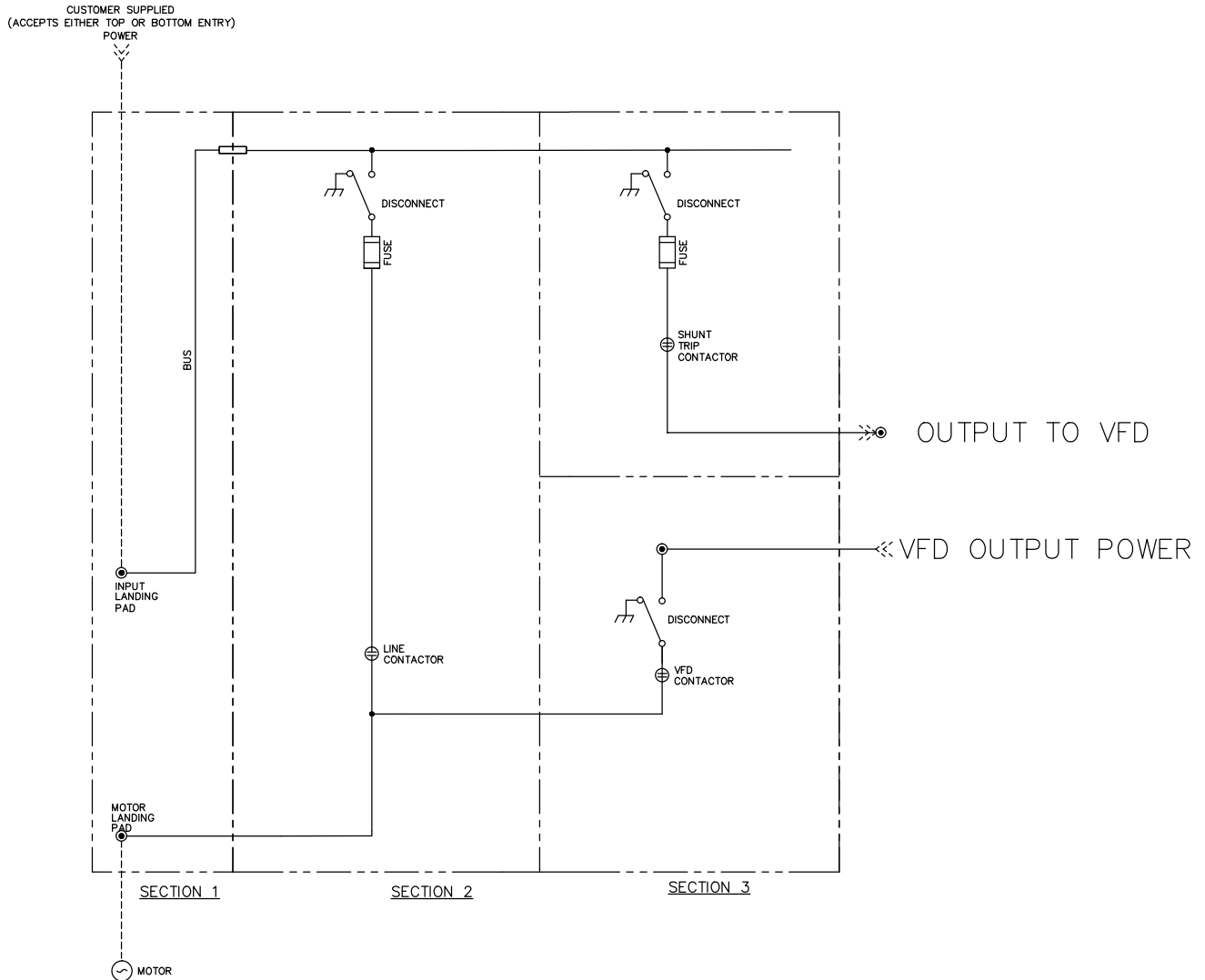
\*All dimensions above assume top entry and a pass-through exit to the neighboring converter or bottom exit. Contact Benschaw for additional entry/exit options.

\*Consult factory for larger sizes or alternate enclosure ratings.



# MEDIUM VOLTAGE DRIVE FEEDER

## DRIVE FEEDER WITH FULLY ISOLATED ATL BYPASS



Note that to run in ATL mode, the ATL disconnect must be closed and the VFD disconnect must be opened.

\*With the standard configuration, two load side connection points are required — one to the two High ATL Starter/ VFD Output Isolation Sections and one to the Main VFD Disconnect Section. This option includes the following in order have only one load power connection point for CFMVM2LBYP-160A-2300/4160-12.

- NEMA 12 Enclosure approx. 92.5”H x 18”W x 36”D
- Motor Landing Pad
- 800 A Non-insulated Bus



MV Soft Starters

Full Voltage Assemblies

MV Switchgear Assemblies

Lineups/Motor Control Centers

MV Variable Frequency Drives

IEC Motor Controls

Specialty Products

Projects



# Medium Voltage Motor Control Solutions

**SECTION 13**

**Enhanced Safety**

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- Mimic Bus ..... 140
- Live Line Indication ..... 141
- Ground Balls ..... 141

## ENHANCED SAFETY

Benshaw’s equipment is designed to be rugged, reliable and, above all, safe. We are proud to be able to offer some of the latest safety technology available on the market and incorporate it into solutions to meet your needs.

### ENHANCED SAFETY FEATURES

Description	List Price
8 RTD Input Module	CF
Start/Stop Push Button	CF
Power On/Run Pilot Light	CF
Three Position Selector Switch	CF
Four Pole Relay	CF
Electronic Overload Relay	CF
Zero Ground Fault Current Transformer	CF
Motor Winding Heater Contactor	CF
Control Wire Way	CF
Horizontal Tin Plated Cooper Power Bus	CF
Insulated Bus Covering	CF
Top Hat Cable Entry Enclosure	CF
Distribution Class Arresters	CF
Ground Balls	CF
Load Motor Power Cable	CF
Live Line Indication	CF
Thermal Viewing windows	CF
Power Factor Contactor	CF
Power Factor Capacitors	CF

CF - Consult Factory

### MIMIC BUS

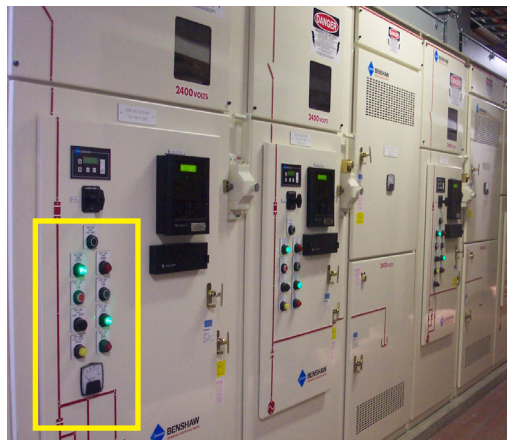
Benshaw’s mimic bus enables the final end user to control the equipment from a safer distance (outside the arc flash hazard zone). This remote control gives our customers more system information for faster decision making or troubleshooting during power outages.



## ENHANCED SAFETY

### LIVE LINE INDICATION

Benshaw live line indicator provides a visual reminder that a circuit is live, which reduces the risk of accidents, speeds up the fault-finding process and ultimately saves lives. At Benshaw your safety is our priority.



### GROUND BALLS

Ground balls help to prevent electrical shock when personal must enter an energized or deenergized piece of electrical equipment.

The grounding balls are a permanent installing in your electrical system and are, typically, attached to ground bus bars and contactors or any other power terminations.

The design of the ball component allows for easy and accessible clamping of the ground apparatus.





MV Soft Starters

Full Voltage Assemblies

MV Switchgear Assemblies

Lineups/Motor Control Centers

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Projects



# Medium Voltage Motor Control Solutions

**SECTION 14**

**Technical Definitions**

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Arc Mitigation vs Arc Resistant ..... 145

# METAL ENCLOSED VS METAL CLAD

## METAL-ENCLOSED vs METAL-CLAD SWITCHGEAR

Medium voltage metal-enclosed and metal-clad switchgear are both used in power distribution systems for isolation, protection, and control of electrical equipment. The main difference between the two lies in the design and construction.

### METAL-ENCLOSED SWITCHGEAR

Metal-enclosed switchgear has no grounded metal barriers between compartments, allowing the enclosed equipment to be located closer together. This type of design is typically used where a high degree of protection is not required.

The overall design of metal-enclosed gear is typically more compact, making it a better fit for installation with limited space. It also typically costs considerably less than metal-clad gear.

Metal-enclosed gear is widely used in various industrial, commercial, and utility applications due to its compact design, cost-effectiveness, and suitability for less demanding safety requirements. Some common applications include:

- Industrial plants and facilities, where space constraints and cost considerations make it an attractive option.
- Commercial buildings which require reliable power distribution but may not need the heightened safety features of metal-clad gear.
- Utility distribution networks, where metal-enclosed gear can be used to manage and control power distribution in less critical parts of the network.

### METAL-CLAD SWITCHGEAR

Metal-clad switchgear features a grounded metal barrier that separates individual compartments (like the circuit breaker, bus bar, and control compartments) to ensure complete isolation. It generally offers a higher degree of protection, making it ideal for applications with strict safety requirements.

The grounded metal barriers between compartments prevent the spread of arc faults, enhancing safety for operating personnel and equipment. An interlocking mechanism prevents the inadvertent operation of the switchgear, ensuring proper functioning and reduced risk of accidents. The actual metal-clad cabinet is designed to protect the electrical equipment from dust, moisture and corrosive environments for long-lasting performance and reliability.

The key components in medium voltage metal-clad switchgear include:

- Main circuit breaker compartment which houses a vacuum or SF6 gas-insulated circuit breaker responsible for interrupting high currents.
- Bus bar compartment which connects the main circuit breaker to the other switchgear components.
- Instrument and control compartments (control logic, relays and meters)

Grounded metal barriers separate each compartment, ensuring complete isolation and enhanced safety.

The overall design of metal-clad gear is typically much larger than metal-enclosed gear. It is also more expensive than metal-enclosed gear.



# ARC MITIGATION VS ARC RESISTANT

## ARC-RESISTANT vs ARC MITIGATION

An arc flash is a dangerous condition associated with the explosive release of energy caused by an electrical arc due to either a phase-to-ground or a phase-to-phase fault. This fault can be the result of any number of factors, including accidental contact with electrical systems, build-up of conductive dust, corrosion, or improper work procedures. An arc-flash event releases a tremendous amount of energy in the form of thermal heat, toxic fumes, pressure waves, blinding light, sound waves, and explosions that can result in serious injury and even death. Excessive temperatures cause the air and metal in the path of the arc to expand and explode, creating an arc blast.

Arc-resistant switchgear is designed to provide a path of least resistance to safely exhaust the incident energy in the equipment using arc ducts or plenums to a secure outdoors area and away from equipment operators. The system is often designed with vents or flaps that will open under the pressure of an arcing fault and redirect the super-heated gases and arc flash energy out of the equipment, away from personnel.

Arc-resistant switchgear provides a significant increase in safety, and it helps prevent damage to adjacent equipment. Non-arc-resistant switchgear does not provide the same level of safety.

Arc-resistant switchgear is available for low- and medium-voltage systems and in various ratings:

Type 1 – must be arc resistant in the front of the equipment only

Type 2 – must be arc resistant around the entire perimeter of the equipment

Type 2B – must be arc resistant around the entire perimeter of the equipment, even with instrument or control compartment doors open.

Type 2C – must be arc resistant between adjacent compartments within the assembly, as well as around the entire perimeter of the equipment.

Note: Arc-resistant switchgear is not designed to preserve the operational condition of the equipment, only to protect operating personnel located outside of the equipment.

## ARC-FLASH MITIGATION IN EQUIPMENT DESIGN

Equipment design techniques can be used to help reduce an arc flash hazard. A few of the equipment options include remote racking, remote operators, zone-selective interlocking (ZSI), maintenance switches, arc-fault relays, and arc flash protective equipment.

Arc-Flash Mitigation, also known as Arc-Flash protection utilizes existing motor protection features already available in most protection relays and the addition of a sensor to determine when a fault has reached the a critical stage and removes to incident energy prior to an Arc Event taking place.

In order to implement an arc mitigation system into you switchgear you will need the following;

A protection relay with Arc-Flash capabilities

A fiber optic based sensor, either a point sensor a continuous cable

A circuit breaker that can open in 3 cycle or less from the time a fault signal is given.

Specifying the correct overcurrent protection is an important factor when implementing a safe system. This can be accomplished by first completing an arc flash study. Following that, adjusting the trip settings on the overcurrent-protection circuit breakers can be an effective method in mitigating the amount of arc flash incident energy. Carefully reviewing and analyzing the breaker trip settings as it relates to the arc flash study is an important component in setting up the power system for optimum performance. Typically, in arc flash safety, it is ideal to have the breaker trip at the soonest possible moment in order to mitigate the amount of arc flash incident energy. However, the problem with setting all of the breakers down to the fastest instantaneous trip setting is that it can result in an uncoordinated electrical system and compromise the safety of the overall electrical system.

A better solution may be an arc-flash relay, a device that can help mitigate incident energy in both medium- and low-voltage switchgear. There are arc flash relays that measure both light flash and current to detect arc flash occurrences and help mitigate the incident energy. The benefit of detecting light output from an arc flash while measuring current to ensure safe operation, while minimizing nuisance tripping. Arc flash relays can be a good solution for both new and retrofit-type installations.

The combination of the three units will clear a fault in approximately 5 cycles.

By removing the incident energy before it builds to a point of no return, the contributing energy is removed from the system.

The process provides personal safety to those within the arc blast area and should not result in the destruction of the switchgear.

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