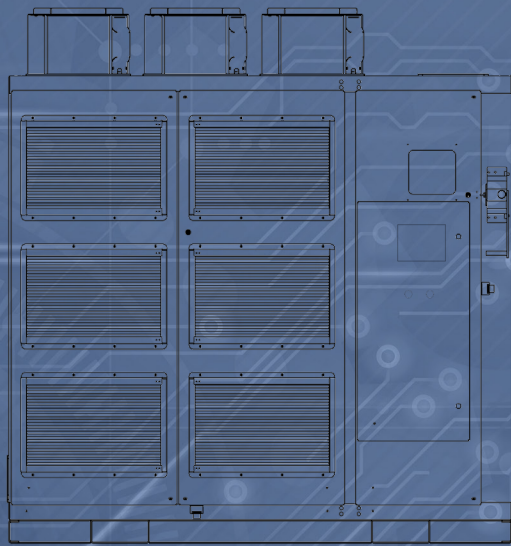




**BENSHAW**  
Applied Motor Controls



## ***MVH2 Series***

### Medium Voltage VFD

FULL-SIZE DRIVE PERFORMANCE ... SMALL FOOTPRINT DESIGN  
2.3 – 4.16KV UP TO 154A

***Rapid | Rugged | Global***

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***When the application is critical ... and the environment harsh ... customers specify Benshaw more than any other brand.***



Benshaw is uniquely qualified to help you achieve your motor and machine control objectives. Our state-of-the-art manufacturing facilities combine the convenience of regional proximity with the cost advantages of a single, large scale operation and an extensive global supply chain.

We thrive on complex applications and work diligently to bring cost-effective standard products and engineered solutions to our customers. All operations are ISO certified, and all components, enclosures, parts, and materials are inspected, tracked, and kitted per ISO 9001 protocols to ensure timely processing of orders.

We manufacture an extensive selection of standard motor controls and drives — serving a wide range of industries. And if a standard product doesn't fit your requirements, our design and engineering teams can help tailor a solution that does, no matter how complex or demanding the application. We approach complex motor and machine control applications with unrivaled engineering and design experience, working closely with our customers to produce cost effective motor controls and drives that precisely match requirements.

From concept to final assembly, Benshaw's objective is to deliver world class performance to customers through our ...

- Broad product lines
- Global operations footprint
- ISO 9001 quality controlled production process
- Commitment to operational excellence



# Introduction

***Benshaw's MVH2 Series Medium Voltage Variable Frequency Drive provides full-size drive performance with a compact, rugged design.***

Benshaw MVH2 Series Medium Voltage VFDs utilize cascaded H-bridge multi-level and overlapping wave technology for low harmonic content and a nearly perfect sine wave output. 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.

## COMPACT DESIGN

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

- UL Listed to 154 amps @ 4160V
- 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 for up to 4 motors (optional)



## STANDARD NEMA 1 ENCLOSURE

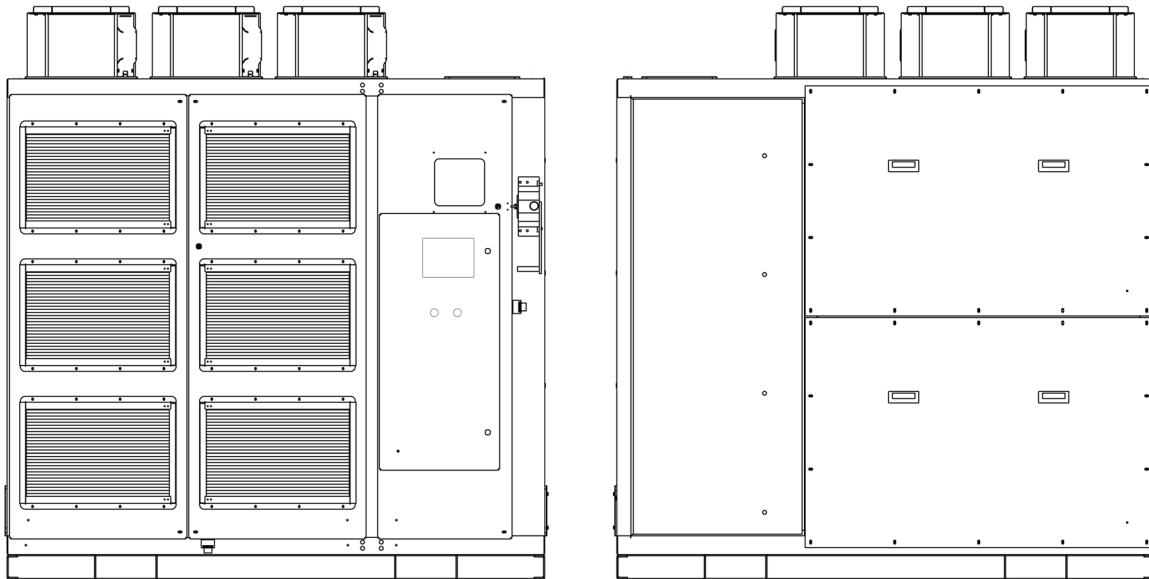
Designed to provide the performance of a full-size standard drive in a small footprint layout. Ideal solution for retrofit projects or any installation with space constraints.



**Single-sided front access service zone** — Switchgear style VFD ideal for a wall-mounted or back-to-back installation.

**Isolation switch, fuses and contactor**

2.3 kV – 4.16 kV, up to 154A



## PART NUMBER ASSEMBLER

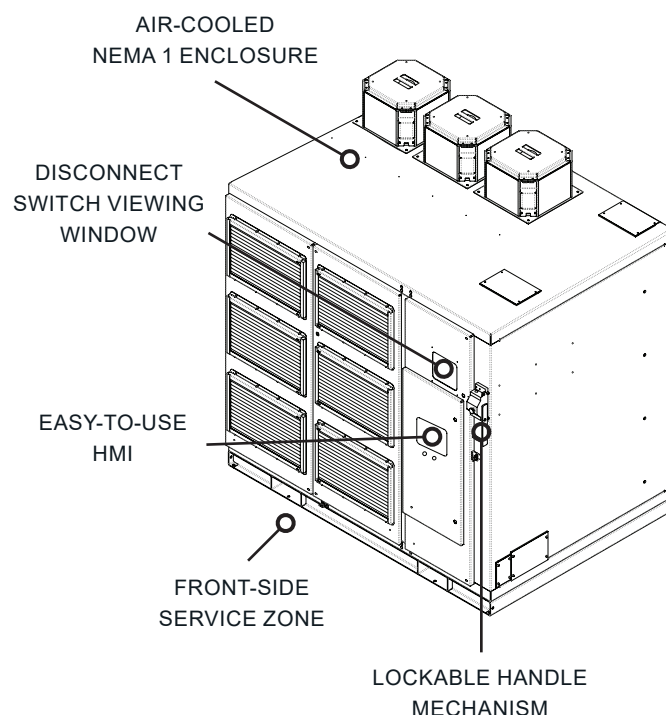
|      |   |   |   |   |   |     |   |     |   |      |   |   |    |   |   |   |    |   |     |   |  |                                  |
|------|---|---|---|---|---|-----|---|-----|---|------|---|---|----|---|---|---|----|---|-----|---|--|----------------------------------|
| MVH2 | - | A | U | 6 | - | 042 | - | 042 | - | 0048 | A | - | CF | - | I | - | NB | - | FSO | - | N1   | N1 = NEMA 1 Enclosure (standard) |
|      |   |   |   |   |   |     |   |     |   |      |   |   |    |   |   |   |    |   |     |   | FSO = Front Service Only / DSO = Double Side Access (e.g. front & rear access) |                                  |
|      |   |   |   |   |   |     |   |     |   |      |   |   |    |   |   |   |    |   |     |   | NB = No cell bypass / CB = Cell Bypass / RB = Redundant Cell Bypass            |                                  |
|      |   |   |   |   |   |     |   |     |   |      |   |   |    |   |   |   |    |   |     |   | I = Inline Contactor / N = No Inline Contactor                                 |                                  |
|      |   |   |   |   |   |     |   |     |   |      |   |   |    |   |   |   |    |   |     |   | CF = Fusible Disconnect / ND = No Disconnect                                   |                                  |
|      |   |   |   |   |   |     |   |     |   |      |   |   |    |   |   |   |    |   |     |   | A = Air Cooling / W = Water Cooling  |                                  |
|      |   |   |   |   |   |     |   |     |   |      |   |   |    |   |   |   |    |   |     |   | Rated Unit Amps rms  |                                  |
|      |   |   |   |   |   |     |   |     |   |      |   |   |    |   |   |   |    |   |     |   | Output Rated Voltage Vrms 023 = 2300V, 042 = 4160V                             |                                  |
|      |   |   |   |   |   |     |   |     |   |      |   |   |    |   |   |   |    |   |     |   | Input Rated Voltage Vrms 023 = 2300V, 042 = 4160V                              |                                  |
|      |   |   |   |   |   |     |   |     |   |      |   |   |    |   |   |   |    |   |     |   | 5 = 50Hz Input Frequency / 6 = 60Hz Input Frequency                            |                                  |
|      |   |   |   |   |   |     |   |     |   |      |   |   |    |   |   |   |    |   |     |   | I = IEC / U = UL   |                                  |
|      |   |   |   |   |   |     |   |     |   |      |   |   |    |   |   |   |    |   |     |   | A = Asynchronous Motor / S = Synchronous                                       |                                  |
|      |   |   |   |   |   |     |   |     |   |      |   |   |    |   |   |   |    |   |     |   | Benshaw MV Drive H2 Product Type   |                                  |

# Product Structure

***Benshaw's next generation MVH2 Series multi-purpose variable frequency drive provides a solution for all kinds of applications ... in nearly every industrial sector.***

## KEY FEATURES

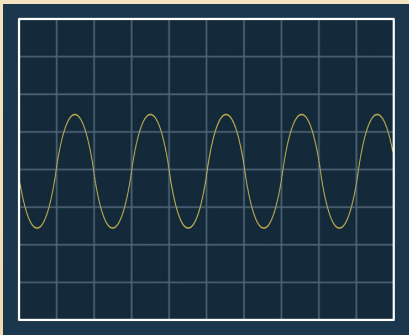
- Current range: 31 – 154 A
- Voltage range: 2.3 – 4.16 kV
- 50 kAIC short circuit fault rating
- 60kV BIL
- 400 A load break, 5 kV rated disconnect switch, mechanically interlocked
- Supports standard induction, synchronous or permanent magnet motors
- Voltage source multi-cell inverter
- Modbus RTU standard, DeviceNet, Profibus, Ethernet optional
- Class H dry type transformer (Al windings) with embedded RTDs
- Powerful main controller
- HMI monitoring



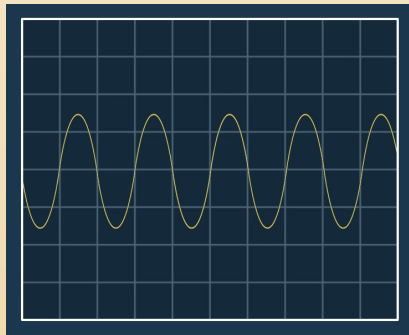
## DIGITAL SIGNAL PROCESSOR

The main controller chip uses TI's TMS320 F28335 digital signal processor (DSP). This device has 150 MHz high-speed processing capability, a 32-bit floating-point processing unit and six (6) DMA channels, supporting ADC, McBSP and EMIF.

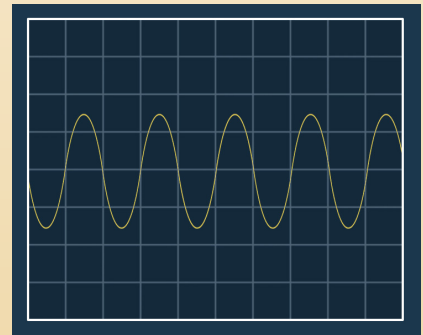
The DSP provides an average performance improvement of 50% over previous generation DSPs. At the same time, through the application of better control algorithms, the waveform and output harmonics of the inverter is significantly improved when running at low-frequency currents.



CURRENT WAVEFORM AT 2 HZ



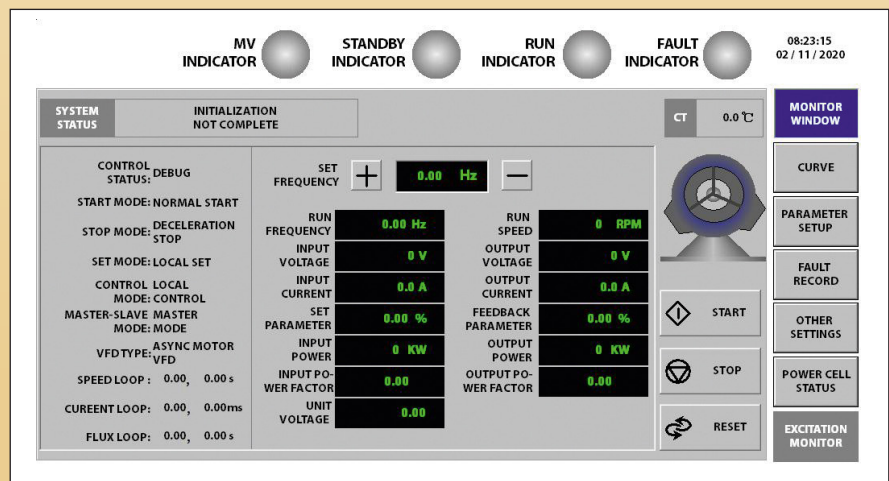
CURRENT WAVEFORM AT 5 HZ



CURRENT WAVEFORM AT 10 HZ

## INTUITIVE HMI

- 10-inch touch screen
- Convenient control system status and monitoring
- Powerful data control (data logging, diagnostics and information)
- User-friendly interface (high definition display with high data throughput)
- Multi-language display



## Advanced Functions

*Benshaw's MVH2 drive is a full-featured, medium voltage VFD designed for global acceptance. The built-in HMI supports multiple languages, meeting IEC and IEEE standards for performance and safety.*

### **Flying Start**

The MVH2 drive will automatically estimate the motor running speed, and apply the same voltage waveform as the motor frequency, preventing over current issues when starting into a rotating load. This feature is ideal when the drive automatically restarts after power loss, or when switching from network power to drive mode.

### **Instant Power Loss**

The MVH2 variable frequency drive will continue to run even in the event of a voltage drop or loss of power (less than 1,000 ms). This ensures continuous operation for critical operations.

### **Torque Boost**

Increase the output voltage at low frequency to boost the motor torque when running at low speed. The torque boost function supports high breakaway torque requirements while providing smooth, reliable starting.

### **Interface Board**

The core of the interface board is a commercial PLC. The module comes standard with an Ethernet interface and supports the Siemens S7 and TCP/IP protocols in order to support a variety of terminal connections. In addition, the CPU module is integrated with one RS485 interface, able to communicate with third party equipment such as the MV drive and touch screen. The interface board is also equipped with an expansion CM01 signal board to provide RS232/RS485 free communication and support Profibus and Ethernet TCP/IP communication protocols.



### **Interface Logic Controller**

The interface logic controller uses a smart PLC as a standard (core) component. The PLC is equipped with a dedicated high-speed processor chip. Its basic instruction execution time can be up to 0.15  $\mu$ s.

### **Parameter Downloading and Uploading**

System and motor parameters can be easily downloaded and uploaded with a Windows PC-based software tool. The software provides advanced service functionality and guarantees the correct parameter settings after replacement of components.

### **Master-Slave Control**

Supports multiple VFD systems with several motors running on the same load such as mills or conveyor belts. The VFD analyzes torque and load to balance motor speed and torque.

### **Power Cell Braking Function**

This function enables high braking torque at low speed, guaranteeing a quick stop time if required.

### **Neutral Point Shift\***

In the event that one power cell is internally bypassed because of a fault, the other power cells can adjust the output voltage to maintain balance, changing phase position to maintain continuous operation.

### **Synchronous Transfer\***

Phase lock loop technology is used to adjust the output of the drive so that the frequency, phase position and amplitude can be matched to the network. Switch motor power from the medium voltage drive to network power (bypass mode) and back (drive mode). Multi-motor synchronous transfer allows users to start up to four MV motors sequentially in drive mode and control the last motor's speed.

\* Future



# 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   |
| Performance                                | Speed control  | ≥ 96%  |
|  |  | 0.1% closed loop, 0.5% open loop   |
| Control Inputs                             | Analog   | Resolution: 1 RPM  |
|  |  | 2 x Programmable isolated input: 4-20mA, 2-10V                                       |
|  | Digital  | 1 x Excitation feedback 4-20mA, 2-10V  |
| Control Outputs                            | Analog   | 14 Isolated inputs: 24Vdc  |
|  |  | 2 Fixed outputs: 4-20mA / 2-10V  |
|  | Relay  | 2 Programmable outputs: 4-20mA / 2-10V   |
| Communication                              | Fieldbus communication                               | 22 Isolated outputs with dry contacts  |
|  |  | Standard Modbus RTU  |
| Power Cell Bypass Function (86A and below) | Fieldbus communication                               | DeviceNet / Profibus / Ethernet IP (optional)  |
|  |  | 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.**   |
| Ambient                                    | High productivity and low mean time to repair (MTTR) |  |
|  |  |  |
|  |  |  |
| Finishing                                  | Color  | 23°F ... 104°F (-5°C ... 40°C)   |
|  |  | < 95% non-condensing   |
|  |  | 0 ... 5000 ft (above 3300 ft - 1% de-rating for every additional 330 ft)             |
| Conformities Standards                     | Electromagnetic compatibility                        | ANSI 61 Gray   |
|  |  | Special paint color optional   |
|  |  | IEEE 519-2014  |
|  |  | IEC 61800-3  |
|  |  | UL/cUL (up to 154A) 4160V only. *2300V UL future.                                    |

\* 230V power supply supplied by others.

\*\* Future

| FEATURE                      | SPECIFICATION/RATING  |                                   |
|------------------------------|---|-----------------------------------|
| 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) |
| Ratings                      | Short circuit withstand   | 50kA @ 4160V                      |
|                              | BIL   | 60kV                              |
| Standard 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                           |

## MODEL RATINGS

| MODEL NUMBER                          | VOLTAGE | APPROX<br>MAX<br>HP* | FLA | DIMENSIONS (IN)** |    |    | APPROX<br>WEIGHT<br>(lbs) |
|---------------------------------------|---------|----------------------|-----|-------------------|----|----|---------------------------|
|                                       |         |                      |     | H                 | W  | D  |                           |
| 2300V                                 |         |                      |     |                   |    |    |                           |
| MVH2-AU6-023-023-0077A-CF-I-NB-FSO-N1 | 2300    | 300                  | 77  | 91.5              | 86 | 60 | 5200                      |
| MVH2-AU6-023-023-0154A-CF-I-NB-FSO-N1 | 2300    | 600                  | 154 | 91.5              | 86 | 60 | 5250                      |
| 4160V                                 |         |                      |     |                   |    |    |                           |
| MVH2-AU6-042-042-0031A-CF-I-NB-FSO-N1 | 4160    | 200                  | 31  | 91.5              | 86 | 60 | 3820                      |
| MVH2-AU6-042-042-0040A-CF-I-NB-FSO-N1 | 4160    | 300                  | 40  | 91.5              | 86 | 60 | 4280                      |
| MVH2-AU6-042-042-0048A-CF-I-NB-FSO-N1 | 4160    | 350                  | 48  | 91.5              | 86 | 60 | 4740                      |
| MVH2-AU6-042-042-0061A-CF-I-NB-FSO-N1 | 4160    | 450                  | 61  | 91.5              | 86 | 60 | 5660                      |
| MVH2-AU6-042-042-0077A-CF-I-NB-FSO-N1 | 4160    | 600                  | 77  | 91.5              | 86 | 60 | 6120                      |
| MVH2-AU6-042-042-0096A-CF-I-NB-FSO-N1 | 4160    | 700                  | 96  | 91.5              | 86 | 60 | 6580                      |
| MVH2-AU6-042-042-0104A-CF-I-NB-FSO-N1 | 4160    | 800                  | 104 | 91.5              | 86 | 60 | 7500                      |
| MVH2-AU6-042-042-0115A-CF-I-NB-FSO-N1 | 4160    | 850                  | 115 | 91.5              | 86 | 60 | 7500                      |
| MVH2-AU6-042-042-0130A-CF-I-NB-FSO-N1 | 4160    | 1000                 | 130 | 91.5              | 86 | 60 | 7500                      |
| MVH2-AU6-042-042-0154A-CF-I-NB-FSO-N1 | 4160    | 1200                 | 154 | 91.5              | 86 | 60 | 7500                      |

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.

## Industries and Applications



***Benshaw's next generation MVH2 Series multi-purpose variable frequency drive provides a solution for all kinds of applications ... in nearly every industrial sector.***

From initial engineering through production, factory acceptance testing, commissioning and beyond, Benshaw is committed to helping customers achieve their applied motor control objectives. Our customer-centric approach to motor control and protection — combined with decades of experience in applying variable speed drive technologies to real world motor control requirements — provides distinct advantages and true value for our customers.

## PETROCHEMICAL

- Booster fan
- Induced draft fan
- Pipeline transportation pump
- Water injection pump
- Feed water pump
- Submersible pump
- Oil transfer pump
- Brine pump
- Circulating water pump Compressor

## CEMENT

- Kiln draft fan
- Kiln gas blower
- Separator fan
- Kiln drive
- High temperature fan
- Cement mill (Ball mill)
- Dust removal fan
- Circulating fan
- Grate cooler
- Raw material mill fan
- Raw material mill (Vertical mill)
- Coal mill
- Rotating kiln transmission
- Compressive force draft fan

## POWER

- Exhaust fan
- Booster fan
- Force draft fan
- Induced draft fan
- Condensation pump
- Slurry pump
- Water pumping energy storage pump
- Circulating water pump
- Boiler (feed) pump
- Compressor

## MINING & MINERALS

- BFDS
- De-dusting fan
- Main fan
- Axial flow fan
- De-scaling pump
- Mud pump
- Slurry pump
- Water pump
- Feeding pump
- Stirring pump
- Agitating pump
- Drainage pump
- Process pump
- Belt conveyor
- Kiln drive

## MUNICIPAL PROJECTS

- Aeration fan
- Induced draft fan
- Force draft fan
- Submersible pump
- Fresh water pump
- Sewage pump
- Hot water circulating pump
- Lifting pump
- Water booster pump
- Water injection pump

## METALS

- Induced draft fan
- Force draft fan
- Secondary de-dusting fan
- Compressing blower
- Blast furnace blower
- Blast de-dusting fan
- Hydraulic pump
- Electric furnace cooling fan
- Sulfur dioxide blower
- Slag-flushing pump
- Feeding pump
- Water-delivery pump
- Phosphorus removal pump
- Mud pump
- De-scaling pump
- Kneading machine
- Oxygen compressor
- Gas compression pump



## Service and Support

***Why Benshaw? Because when it absolutely has to work, it absolutely has to be from Benshaw.***

From retrofits to repairs, Benshaw is committed to meeting your requirements. Whether you need simple modifications made to a Benshaw control or drive package, a custom-engineered upgrade to optimize production from an existing machine control panel, technical training for key personell, or a turnkey, plant-wide modernization program, Benshaw is here to help.

- Phone support hotline (1-800-203-2416)
- Centralized coordination of all support services
- 24-hour dispatch from our operations in Pittsburgh, PA (USA) and Listowel, ON (Canada)
- Overnight parts shipment

### FACTORY WARRANTY

Benshaw offers a three year warrantee on all of our medium voltage drive packages.\*

Other manufacturers limit their warranties to one year. But at Benshaw, we believe that because we build them better, we can guarantee them longer.



\* With factory startup

## TECHNICAL SUPPORT SERVICES



***Our technical support team is available 24/7  
to answer questions and solve pressing issues ...  
before, during and after the sale.***

Benshaw's knowledgeable Technical Support team can help you evaluate both current and future motor control system requirements and develop a sound strategy for retrofit, upgrade or replacement. We can also help you submit a Request for Service Quotation. All services are performed by trained, experienced service technicians using the latest engineering, diagnostics and testing equipment.

- Retrofits
- Field service
- Factory service
- Technical training support
- Spare/repair parts
- Maintenance



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