Highly Configurable, Medium Voltage Variable Frequency Drive Solutions
Modular. Space Efficient. Built to Perform in Rugged Environments.

For over 120 years, Ward Leonard has provided power solutions to the world’s most demanding Heavy Industry customers. Today, The Ward Leonard Series of medium voltage, 2000-6000HP variable frequency AC drives are the cost effective, reliable and flexible choice for critical applications in a wide range of markets:

- Hydraulic fracturing
- Land-based drilling
- Offshore drilling
- Chemical processing
- Marine
- Material handling
- Mining
- Pulp & paper

Key Advantages

- Multiple configurations for the most space efficient input / output orientation
- Durable “trailerized” portability
- Interoperability with any medium voltage motor
- Seamless integration with pump or compressor station control systems
- Perfect fit for modernization / retrofit applications, as well as new drill rig and frac pump builds
- Easy-to-use software interface with remote log-in screens

Compact Design

- Streamlines installation, commissioning, and maintenance
- Provides integration flexibility
- Delivers a Mean Time Between Failure (MTBF) exceeding 16 years

Packaged Solutions & Support

Ward Leonard has extensive experience designing and developing integrated systems that solve problems associated with our customers’ complex, and severe environment, applications. As a dedicated partner, we provide:

- Packaged motor and drive solutions from 2000-6000HP
- Pre-configured medium voltage AC motor drives for any Ward Leonard, or other, medium voltage motor
- Customized geometric drive configurations to suit your needs
- Pre-tuned, ready-to-use drives – or enable you to tune yourself
- Convenience and security of utilizing one company for both drives and motors – reducing costs and potential interoperability challenges
Reliable Control for a Wide Range of Industries and Applications
Ward Leonard
AC Motor Drives - MV Series

Medium Voltage Variable Frequency Drives from 2000-6000HP

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
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<tbody>
<tr>
<td><strong>Medium Voltage IGBTs</strong> – Each inverter utilizes medium voltage Insulated Gate Bipolar Transistors (IGBTs).</td>
<td><strong>Rock Solid Reliability</strong> – These high-power IGBTs allow a simpler, more reliable inverter design with fewer power switches.</td>
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<tr>
<td><strong>24-Pulse Converter</strong> – Each phase leg of the converter includes a 24-pulse diode rectifier.</td>
<td><strong>Power System Friendly</strong> – This design exceeds the IEEE 519-1992 specification for Total Harmonic Distortion (THD) without requiring filters.</td>
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<tr>
<td><strong>Liquid/Vapor Heat Exchange Cooling Technology</strong> Liquid/vapor heat exchange cooling technology is used in each of the three inverter phase legs (Most Ratings).</td>
<td><strong>Compact Quiet Design</strong> – This form of cooling reduces the ambient noise and saves valuable floor space in your operation.</td>
</tr>
<tr>
<td><strong>Windows®-Based Configuration and Maintenance Tools</strong> For PC-based configuration, the drive tool features:</td>
<td><strong>Faster Commissioning and Maintenance</strong> – These world-class tools improve productivity in commissioning and typical maintenance activities.</td>
</tr>
<tr>
<td>• Animated block diagrams</td>
<td></td>
</tr>
<tr>
<td>• Functionally organized parameters</td>
<td></td>
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<tr>
<td>• Integrated trend window</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>AC Motor Drives - MV Series 4160 Volts Out</th>
<th>Weight lbs. (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motor Shaft hp (kW)</strong></td>
<td><strong>Output Amps IPhaseAC</strong></td>
</tr>
<tr>
<td>Frame 2</td>
<td>2,250 (1,679)</td>
</tr>
<tr>
<td>Frame 3</td>
<td>3,000 (2,238)</td>
</tr>
<tr>
<td>Frame 4</td>
<td>4,000 (2,984)</td>
</tr>
</tbody>
</table>

*110% OL, 60 seconds
Sizes and Configurations To Suit Your Needs

Frame 2

Frame 3

Frame 4
A Look Inside The Ward Leonard AC Motor Drive

1. **Lightning Arrestors – Standard**
   
   Incoming power (top or bottom fed) is protected by distribution class lightning arrestors for suppression of transient surges.

2. **IEEE 519 Compliant 24-Pulse Source**
   
   Each phase leg has its own 24-pulse rectifier input. This design exceeds the IEEE 519-1992 stringent guidelines for input voltage and current distortion. The source diodes are mounted to an air-cooled extruded aluminum heat sink with fuse protection. Each fuse has blown fuse indication, and the DC bus is monitored for fuse loss.

3. **Copper Wound Isolation Transformer – Standard**
   
   An integral copper wound transformer is mounted in the rear of the cabinet. It meets or exceeds standards established by ANSI/IEEE CS7.12.91. The transformer is rated for 239°F (115°C) rise and its insulation system is rated at 428°F (220°C). An electrostatic shield is included for transient resistance.

4. **Input Power Disconnect – Option**
   
   A fused integral 3-phase disconnect option with vacuum contactor allows maintenance personnel to lockout or disable the drive. For additional safety, each of the high voltage doors is mechanically or electrically interlocked with the contactor.

5. **Filtered Air Intake**
   
   Washable input air filters have front access for periodic maintenance.

6. **Integral Pre-Charge AC Reactor**
   
   An AC reactor and medium voltage contactor control the charging of the DC bus, minimizing stress on the fusing and power components.

Compartmentalized design provides voltage class segregation and top or bottom cable feeds.
A Look Inside The Ward Leonard AC Motor Drives - MV Series

I/O Board
- Based on the application, one of two types of I/O boards is available (refer to page 10 for specifications).
- All I/O is terminated to a two-piece modular terminal block for ease of maintenance and troubleshooting.

Blower Assemblies
- Quiet (<80 dB(A) at 1 m), backward-curved impeller fans circulate air throughout the enclosures, pulling air from the bottom filter assemblies and venting it out the top of the cabinets. Redundant fan assemblies can be provided as an option.

Roll Out Inverter Phase Leg Assemblies
- The three modular phase leg assemblies include:
  - Medium voltage IGBTs
  - DC bus capacitors, oil-filled for long life
  - Gate driver circuit board
  - Heat pipe cooling assembly (most ratings)
  - 120 V AC to 15 V DC power supply
  - Fiber optic link interface circuit board
- Each phase leg assembly is a neutral point clamped power cell. A phase leg assembly can be easily rolled out (using heavy-duty slides) and replaced in 15 minutes.

Motor Cabling Terminations
- Control panel swings out for access to motor cabling terminations. Both top and bottom motor cabling is supported as a standard.

Application Specific Controls
- Each drive is matched to project requirements with custom control components mounted in this area.

Control
- The single 32-bit microprocessor-based control board combines several key drive functions:
  - Power switch gating
  - Speed and torque regulation
  - Motor and drive protection
  - I/O mapping
  - Diagnostic functions
  - High speed data capture buffering
  - Hosting of optional LAN interface
- The drive is configured from the drive tool.
Power Bridge Technology

Ward Leonard's Power Bridge Design Provides Advantages Over Competing Medium Voltage Technology in Reliability, Footprint and Maintenance

Input Waveform

Output Waveform

Note: Input bypass and output contactors are mounted in a separate cabinet integral to the line-up.
Reliability is Designed Into the Drive

- Medium voltage rated IGBTs minimize the component count
- Neutral point clamped (NPC) power bridge topology improves motor waveform quality while maintaining efficiency
- Oil filled capacitors used instead of limited-life electrolytic type
- Copper wound 239°F (115°C) rise transformer with electrostatic shield standard
- Built in surge and transient protection
- Minimized transformer connections
- Conservative rating practices used on all components

Minimized Component Count

- Reduced parts count achieved by using medium voltage IGBTs
- Fewer ancillary components compared to SGCT/GTO and IGCT technologies*
- No water cooling (deionizers, pumps, heat exchangers)
- Designed to minimize opportunity for failure (by using fewer parts) rather than distributing failure (by using redundant parts)

Designed to a Mean Time Between Failure of More Than 16 Years

* SGCT – Symmetric Gate-Commutated Thyristor; GTO – Gate Turn-Off Thyristor; IGCT – Integrated Gate-Commutated Thyristor
# A Control Offering To Fit Your Application

## Instrumentation Interface

| Drive Tool | • RJ-45 Ethernet™ interface  
• 10 Mbps maximum |
|---|---|
| Meter Outputs | • Motor current A and B, ±10 V  
• Quantity 5 configurable  
• ±10 V, 8-bit resolution  
• Connections via keypad |

## I/O Interface

| Digital Inputs | +24 V dc  
24-110 V dc  
48-120 V ac | • Opto-coupled 10 mA  
Quantity 6 configurable |
|---|---|---|
| Digital Outputs | +50 V dc | • Open collector 50 mA  
Quantity 6, 5 connected to output relays |
| Analog Inputs | 10 V, 4-20 mA | • Quantity 2 ±10 V differential  
8 kΩ impedance  
• Or, quantity 2 4-20 mA,  
500 Ω input impedance  
• 12-bit resolution  
• Configurable |
| Analog Outputs | 10 V | • Quantity 3 ±10 V, 10 mA max  
• User defined  
• 8-bit resolution |
| (Optional) Speed Feedback Resolver Input |  | • Excitation frequency of  
1 or 4 kHz  
• Preferred source for resolvers  
is Tamagawa:  
www.tamagawa-seiki.co.jp |
| Speed Feedback Encoder Input |  | • A quad B with marker  
• Max. frequency of 125 kHz  
• Differential 5 or 15 V dc  
• 5 or 15 Vdc at 200 mA supply |
| Speed Tach Follower Output |  | • Singled ended A-B  
• Max. frequency of 10 kHz  
• External 12-24 Vdc is required |
| Motor Temperature Feedback |  | • High-resolution torque motor temperature feedback  
• 1000 Ω platinum resistor or 100 Ω platinum RTD (RTD uses analog input with signal conditioner) |
| LAN Interface Options | • DeviceNet™  
• Profinet®  
• ISBus  
• Modbus RTU/Ethernet | • TOSLINE®-S20  
• Other available on request  
• Ethernet EGD  
• Ethernet IP |

## Additional Specifications

### Power System Input and Harmonic Data
- 4000–4200 Vac
- Tolerares power dips up to 30% without tripping, complete control power loss ride through of 100 msec
- Frequency: 60 Hz or optional 50 Hz
- Displacement power factor (PF): 0.95 lag
- True PF: greater than 0.95 lag from 10% to 100% load
- ≤ 3% THD (current distortion)
- Meets IEEE 519-1992 standards without filters
- Lightning arrestors included as standard
- Top or bottom cable entry

### Converter Type
- AC fed 24-pulse diode, non-regenerative

### Transformer
- Copper winding
- Electrostatic shield  
+115° C rise
- Insulation class: 220°C
- Cooling: forced air
- Optional fan power secondary winding

### Inverter
- NPC (Neutral-Point-Clamped) configuration
- 3300 V IGBTs for margin, minimum parts count
- Control optically isolated from MV circuits for safety
- Roll-out phase modules for fast maintenance and repair

### Applicable Standards
- C.U.L., CE, UL 347A, NEMA ICS 6, NEMA ICS 7

### Safety Features
- Integral MV disconnect option, door mechanically interlocked
- Door electrical interlocks included as standard

### Operating Environment and Needs
- Temperature: 0° to +40°C no derating, Up to +50°C with derating
- Altitude: Up to 3300 ft/1000 m a.m.s.l. no derating:  
Up to 10,000 ft/3280 m a.m.s.l. with derating
- Fan and Control Power (by user): 460 V, 3-phase, 60 Hz, 3.5–10 kVA  
(other voltages and 50 Hz available)

### Cooling Technology
- Air-cooled with redundant fan option
- Separate converter and inverter cooling paths
- Inverter utilizes liquid/vapor heat exchange cooling technology for long IGBT life (most ratings)

### Sound
- Less than 79 dBA, at 3.1 ft (1m) from enclosure

### Control
- Non-volatile memory for parameters and fault data
- Vector control with or without speed feedback
- Motor simulation mode allows functional testing of system  
(PI.C. LAN interface, and drive I/O)
- Automatic (power loss) restart function for remote applications

### Vector Control Accuracy and Response
- Speed regulator: 20 rad/s  
± 0.01% speed regulation with speed sensor, ± 0.5% without  
• Torque response: 500 rad/s  
• Torque accuracy: ± 3% with temp sensor, ± 10% without

### Protective Functions
- Inverter overcurrent, overvoltage
- Loss of phase and low/loss of system voltage
- Ground fault
- Loss of dc link
- Motor overload
- Over-temperature
Drive/Motor Monitoring & Analysis

The Ward Leonard AC Motor Drives - MV Series keypad, coupled with the Windows®-based drive tool software, brings productivity to your commissioning and maintenance activities.

**Drive Tool Software**

1. **Trend Window**
   - The drive tool has a trend window that allows the user to:
     - Define a trend with variables from function block diagrams or select the variables from a list.
     - Conduct online real time trending with the drive or upload from the drive for trending.
     - Define a link with integrated database for on demand trending.
     - Quickly define a display with the auto scaling toolbar button.
     - Analyze a specific time frame with the zoom in/out toolbar buttons.
     - Create different views using variable hiding.
     - Analyze specific times with cross hairs.
     - Perform frequency-based analysis of the trend using the Fast Fourier Transform (FFT) function.

2. **Extensive Search**
   - Easily access a wide variety of search content such as signals, parameters, and faults.

3. **Live Block Diagrams**
   - Provide live graphical displays of drive sequencing and regulation functions. Live variables shown in green update in real time.

**Drive Keypad**

1. **High Function Display**
   - LCD backlight gives great visibility and long life.
   - Bar graphs, icons, menus, and digital values combine to provide concise status information, often eliminating the need for traditional external meters.

2. **RJ-45 Ethernet Port**
   - Used for the local toolbox connection, with additional rear RJ-45 connection for permanent installation.

3. **Instrumentation Interface**
   - Two analog outputs are dedicated to motor current feedback.
   - Five analog outputs can be mapped to variables for external data logging and analysis.

4. **Interlock Button**
   - Disables the drive.

5. **Switch to Local Mode**
   - Operate the equipment right from the keypad.

6. **Easy-to-Understand**
   - Navigation buttons allow quick access to information without resorting to a PC-based tool.
For more than 120 years, Ward Leonard’s industry-leading motors and controls have provided efficient, reliable power to our customers in Oil and Gas, the Military, Mining and Material Handling, and Alternative Energy. We develop advanced technologies that are built to perform under extreme temperatures, environments and conditions on land and sea.

**Powering Oil & Gas Exploration**

Ward Leonard motors, controls, and drives are the new benchmarks in performance, productivity and durability, and allow rig site operators to drill deeper, longer and with more confidence than ever before.

**Powering Heavy Industry**

From mining and material handling to nuclear power plants, our motors, controls, and drives harness power for mission-critical applications where performance, safety and reliability are of vital importance.

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Ward Leonard’s motor portfolio offers the following certifications:

- ABS-certified
- ISO 9001:2008-certified
- ATEX-approved
- CSA-approved
- CETL-approved