TMEiC

*We drive industry*

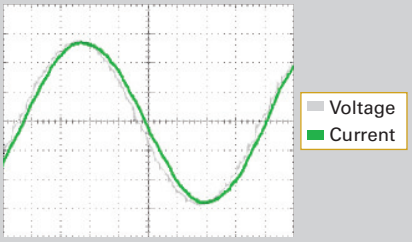

# DURA-BILT 5i MV

## 2000/3000/4000 Series Application Guide

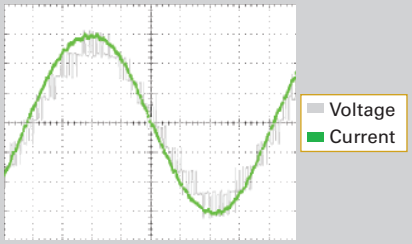
metals | cranes | mining | testing | oil & gas | solar inverters | utilities | cement

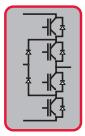
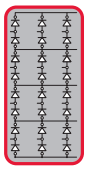
TMEIC has designed a family of medium voltage drives focused on **lowering your cost of ownership.**

### Power System Friendly



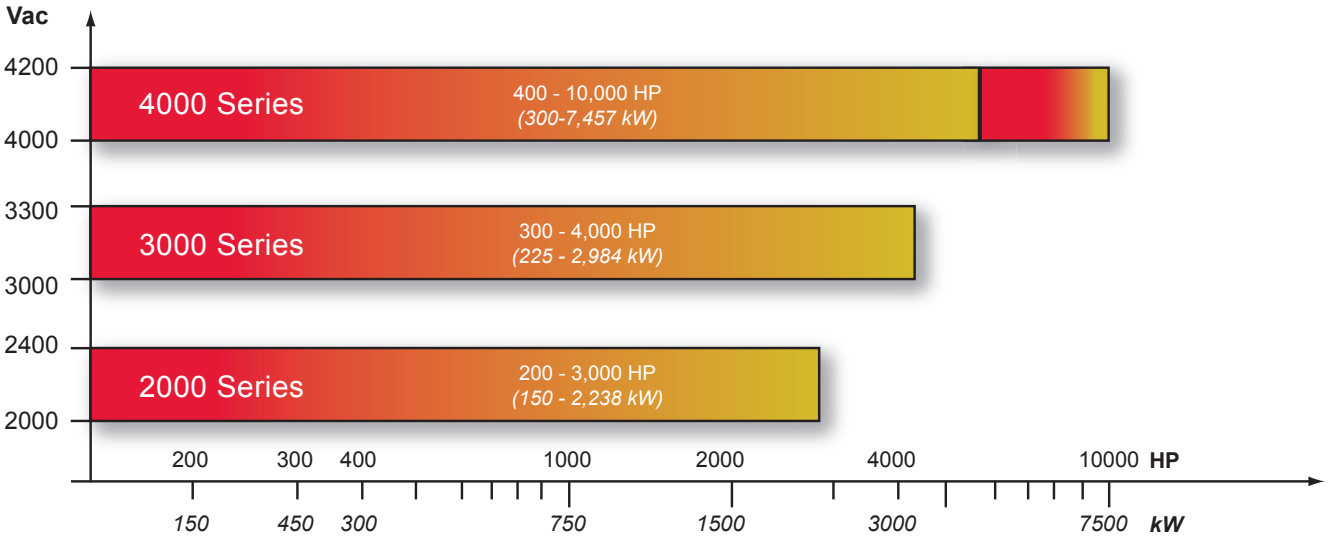

### Motor System Friendly




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

## DURA-BILT 5i MV

Covering a broad range of medium voltage drive applications.



# Bringing Reliable Control To A Wide Variety Of Industries

Water Treatment Plant

The Dura-Bilt5i MV's compartmentalized design streamlines installation, commissioning, and maintenance of medium voltage drives in pumps, aerators and other critical water treatment processes. With a Mean Time Between Failure (MTBF) exceeding 16 years, the Dura-Bilt5i MV is engineered to deliver rock solid performance in virtually any application.

The Dura-Bilt5i MV family of drives can be seamlessly integrated with the rest of your pump or compressor station control system. They can be applied to existing motors and cabling, making them an excellent fit in modernization/ retrofit applications.

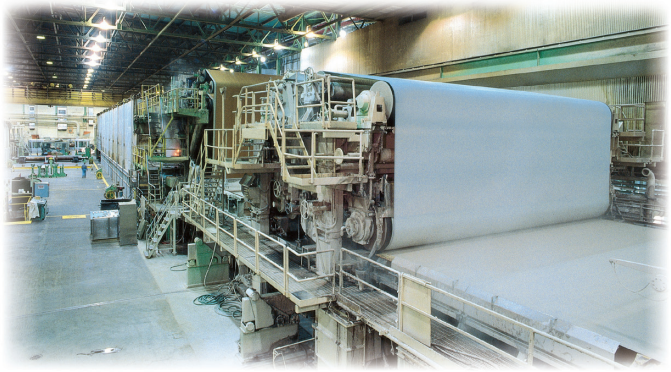
Pump Station

Mining Conveyor

Accurate torque control is a key in controlling large conveyors. The Dura-Bilt5i MV's flux vector algorithm provides the accuracy and response for this demanding application.

Traditional mechanical methods of controlling airflow are inefficient and require considerable maintenance. The Dura-Bilt5i MV provides more accurate and energy-efficient control of airflow while eliminating the maintenance associated with dampers or vanes. Many other cement plant applications are well-served by Dura-Bilt5i MV capabilities, including mills, separators and kilns.

Induced Draft (ID) Fan In Cement Plant



Paper Machine

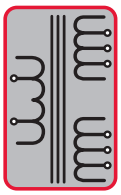
In configuration and maintenance of coordinated drive systems, common pc-based tools are essential. The Dura-Bilt5i MV shares the same TMEIC Control System Toolbox Windows®-based application with the entire family of TMEIC system drives.

# 4000 Series Frame 1 – A Compact Design

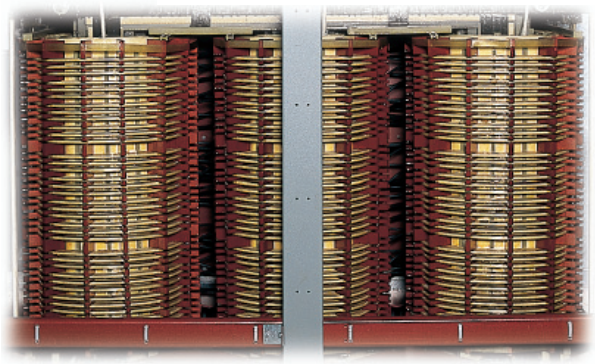
## Differentiating Features:

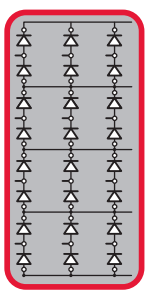
- **Compact design saves valuable floor space**
- **Compartmentalized design provides voltage class segregation and top or bottom cable feeds**
- **Copper wound integral transformer provides reliable operation and simplifies installation**

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

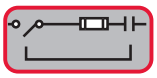


**Copper Wound Isolation Transformer – Standard**
An integral copper wound transformer is mounted in the rear of the cabinet. It meets or exceeds standards established by ANSI/IEEE C57.12.91. The transformer is rated for 239˚F *(115˚C)* rise and its insulation system is rated at 428 ˚F *(220˚C)*. An electrostatic shield is included for transient resistance.

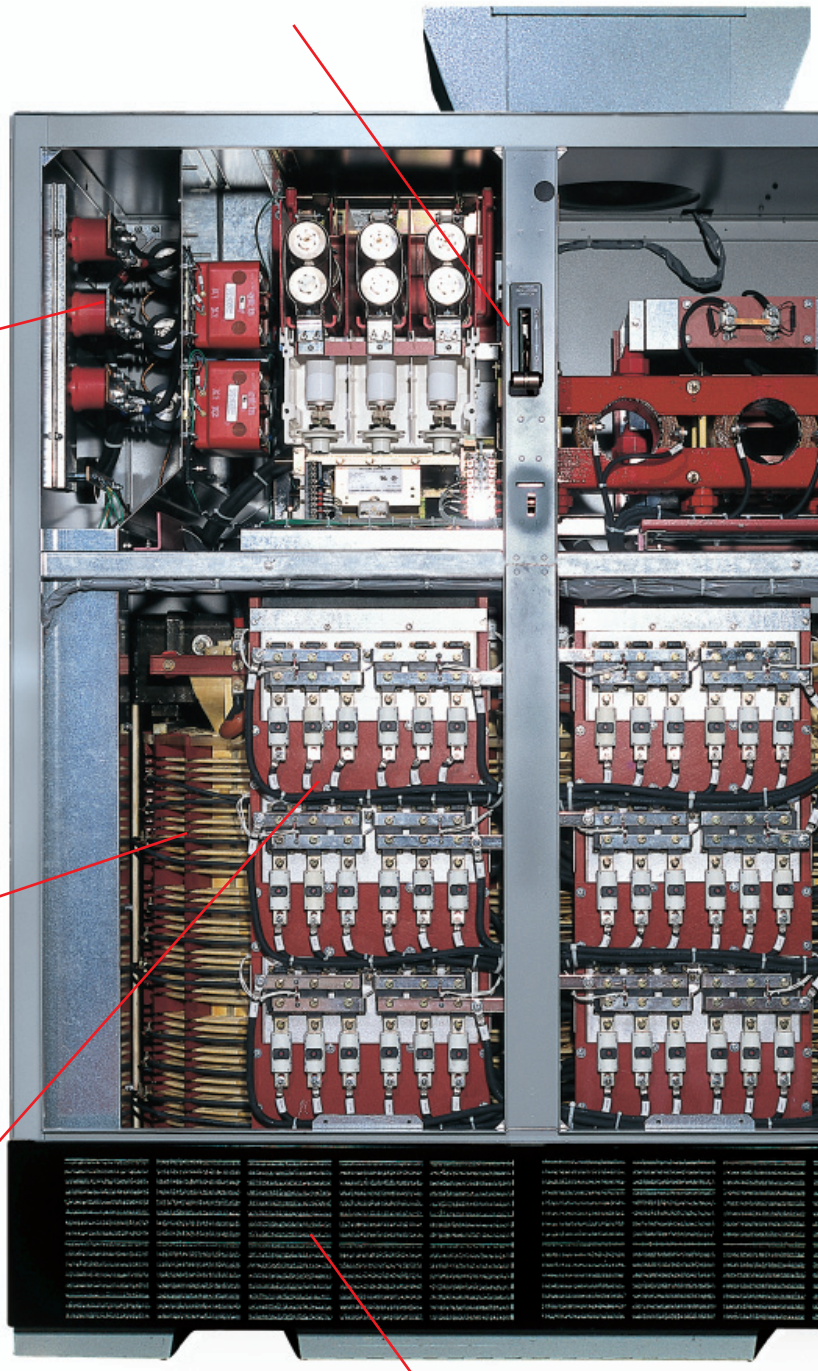




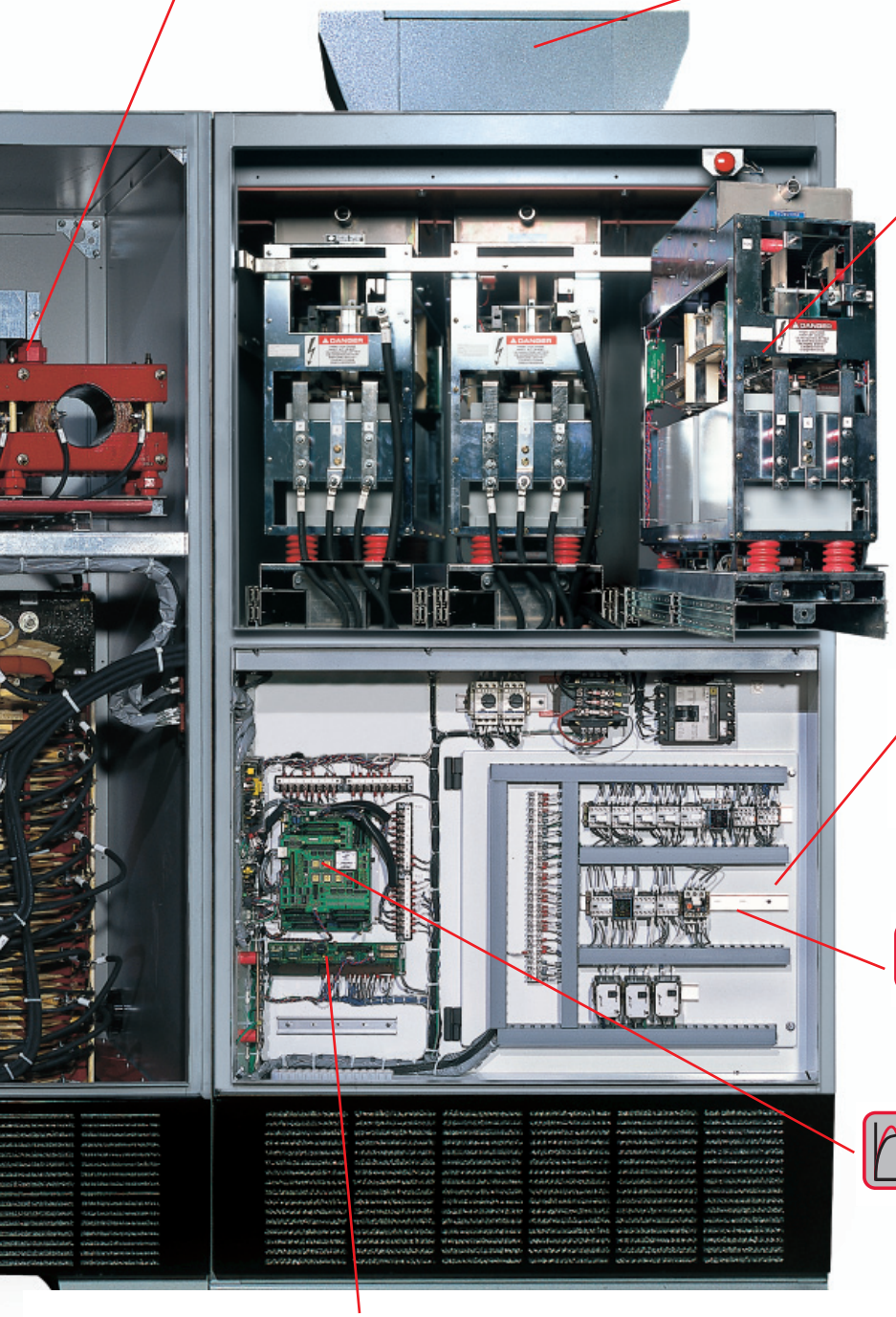
**IEEE 519 Compliant 24-Pulse Source**
Each phase leg has its own 24-pulse rectifier input. This design exceeds the IEEE 519-1992 stringent guidelines for input voltage and current distortion. The source diodes are mounted to an air-cooled extruded aluminum heat sink with fuse protection. Each fuse has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



**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.



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



### 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.

### 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 for maintenance.

### 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

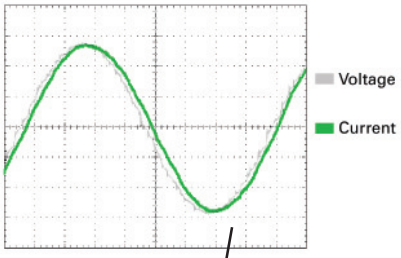
The drive is configured from the Control System Toolbox.

### I/O Board
Based on the application, one of two types of I/O boards is available (refer to page 8 for specifications). All I/O is terminated to a two-piece modular terminal block for ease of maintenance and troubleshooting.

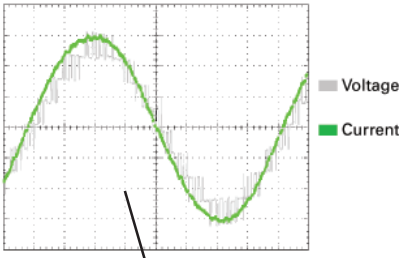
# Dura-Bilt5i MV Power Bridge Technology

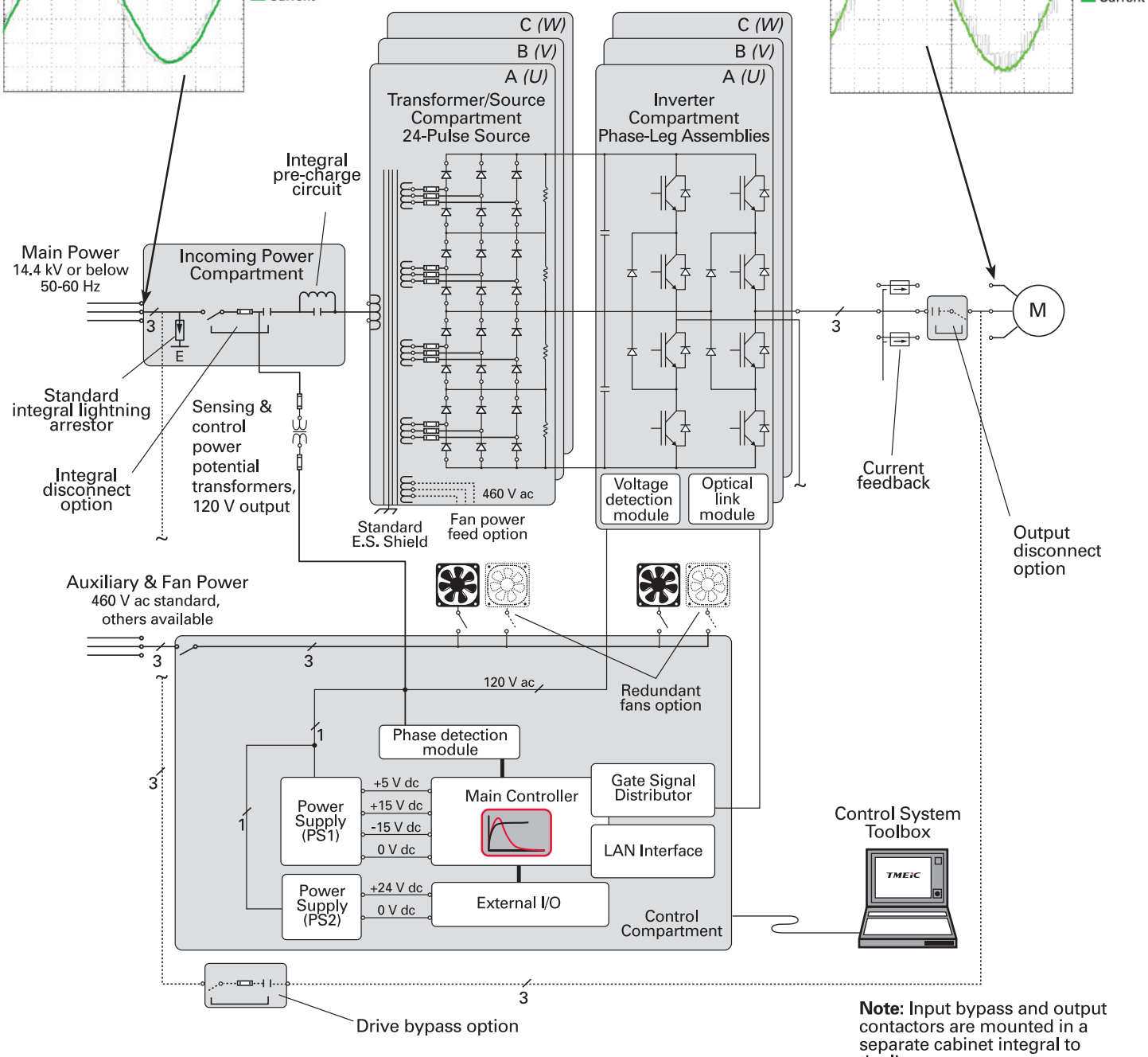
**The Dura-Bilt5i MV power bridge design provides advantages over competing medium voltage technology in reliability, footprint and maintenance.**

*Dura-Bilt5i MV Input Waveform*




*Dura-Bilt5i MV Output Waveform*




**Note:** Input bypass and output contactors are mounted in a separate cabinet integral to the line-up.

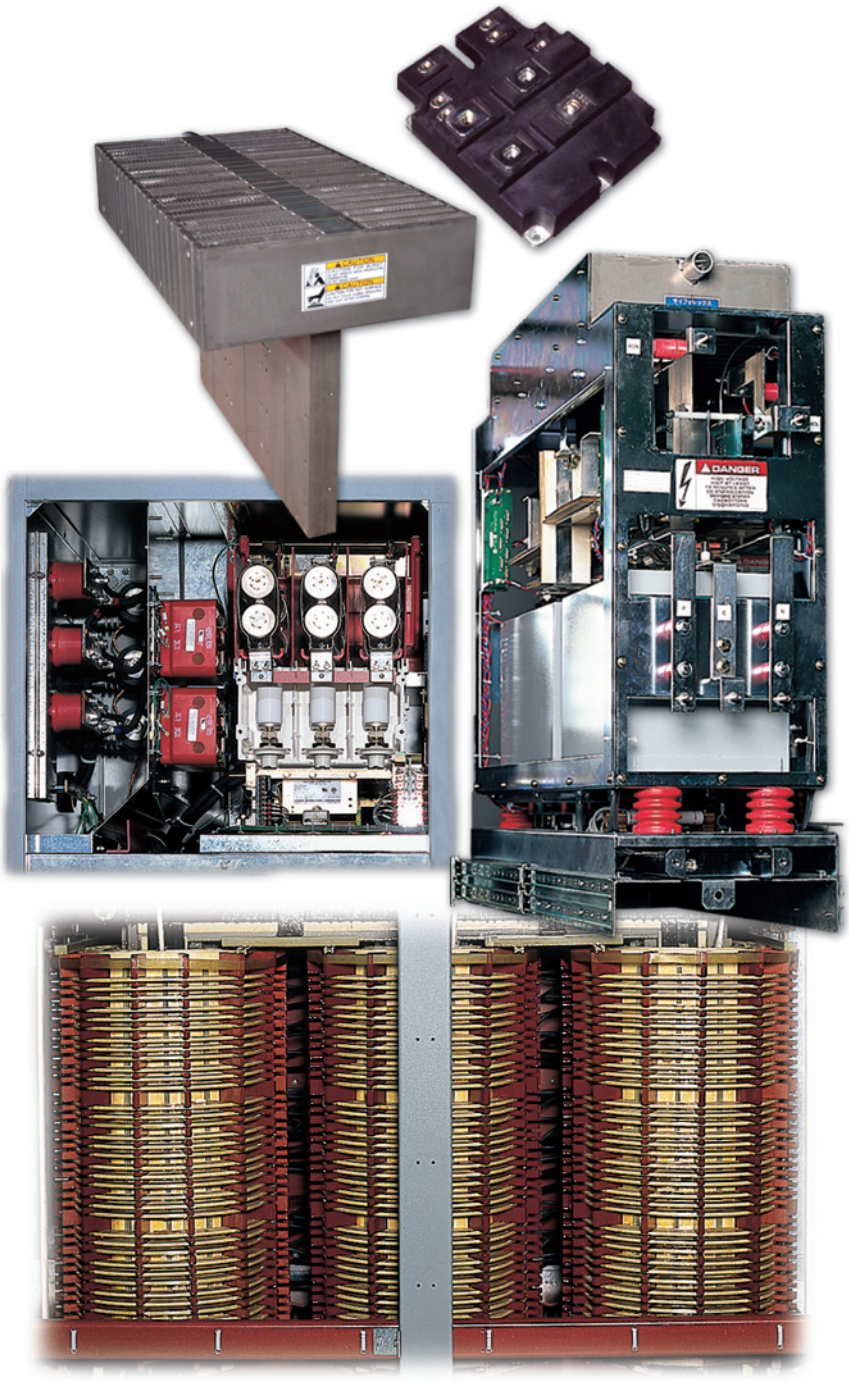
# Designed to a Mean Time Between Failure of more than 16 years

### 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)



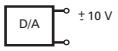
# A Control Offering To Fit Your Application

## Instrumentation Interface

**Toolbox**

- RJ-45 Ethernet™ interface
- 10 Mbps maximum

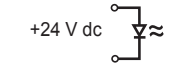
**Meter Outputs**



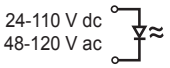

- Motor current A and B, ±10 V
- Quantity 5 configurable, ±10 V, 8-bit resolution
- Connections via keypad

## I/O Interface

**Digital Inputs**

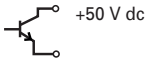



- Opto-coupled 10 mA
- Quantity 6 configurable



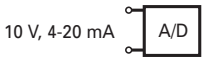

- Opto-coupled 10 mA
- Quantity 1 configurable
- Quantity 1 dedicated

**Digital Outputs**




- Open collector 50 mA
- Quantity 6, 5 connected to output relays

**Analog Inputs**

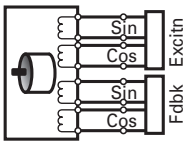



- Quantity 2 ±10 V differential 8 kΩ impedance
- Or, quantity 2 4-20 mA, 500 Ω input impedance
- 12-bit resolution
- Configurable

**Analog Outputs**

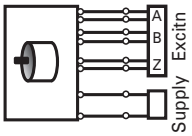

- Quantity 3 ±10 V, 10 mA max
- User defined
- 8-bit resolution

**(Optional) Speed Feedback Resolver Input**



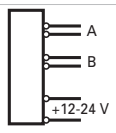

- Excitation frequency of 1 or 4 kHz
- Preferred source for resolvers is Tamagawa: www.tamagawa-seiki.co.jp

**Speed Feedback Encoder Input**



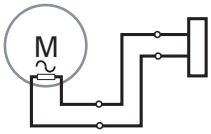

- A quad B with marker
- Maximum frequency of 125 kHz
- Differential 5 or 15 V dc
- 5 or 15 V dc at 200 mA supply

**Speed Tach Follower Output**




- Singled ended A-B
- Maximum frequency of 10 kHz
- External 12-24 V dc 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™
- Profibus-DP™
- ISBus
- Modbus RTU/Ethernet
- TOSLINE®-S20
- Other available on request
- Ethernet EGD
- Ethernet IP

## Additional Specifications

**Power System Input and Harmonic Data**

- Voltage: up to 7.2 kV, 3-phase, +/-10% continuous (Up to 14.4 kV available)
- Tolerates 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**

- CUL, CE, UL 347A, NEMA ICS 6, NEMA ICS 7,

**Safety Features**

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

**Output**

- 0-120 Hz, 3% or less motor current harmonic distortion
- Five-level output for motor-friendly waveform
- Optional integrally mounted output filter
- Top or bottom cable entry

**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**

- Air-cooled with redundant fan option
- Separate converter and inverter cooling paths
- Inverter utilizes heat pipe 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 (PLC, 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 DB5i keypad, coupled with the Windows®-based Control System Toolbox, brings productivity to your commissioning and maintenance activities.**

### Integrated Trend Window

The toolbox application has an integrated trend window that allows the user to:

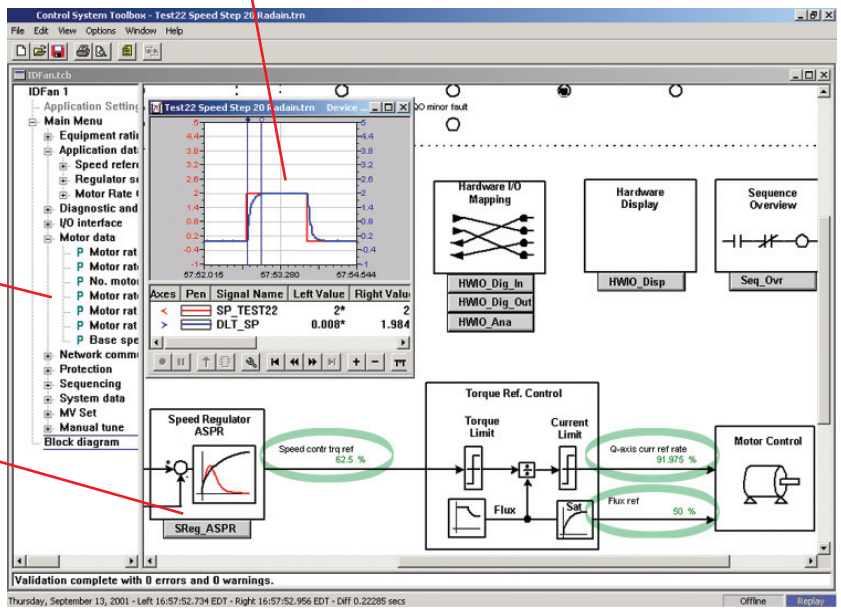
- Define a trend with drag-and-drop variables from function block diagrams or select the variables from a list.
- Conduct online real time trending with the drive or upload the capture buffers in the drive for trending.
- Define a link with integrated historian database for historical trending.
- Quickly 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.

### Outline View

Functionally organized parameters and variables allow quick access to any given function.

### Animated Block Diagrams

Provide an animated graphical display of drive sequencing and regulation functions. Animated variables are shown in green, and the buttons are used to navigate to associated functions.




Control System Toolbox

### 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 analog meters

RJ-45 Ethernet port is used for the local toolbox connection, with additional rear RJ-45 connection for permanent installation


Dura-Bilt5i Keypad

Easy-to-understand navigation buttons allow quick access to information without resorting to a PC-based tool

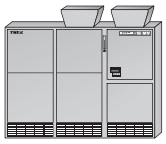
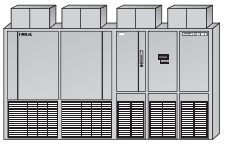
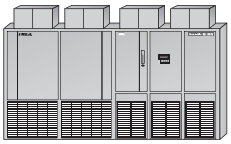
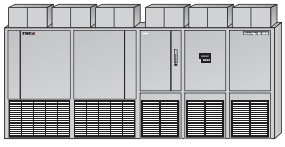
Switch to local mode and operate the equipment right from the keypad

### 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

Interlock button disables the drive

# Dura-Bilt5i MV
# A Family of Medium Voltage Drives

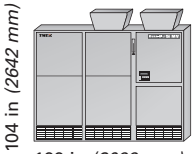
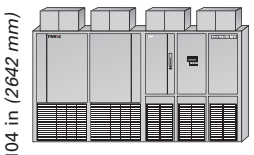
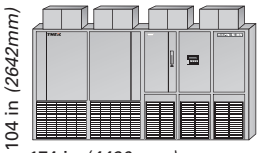
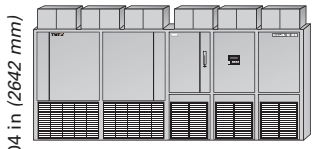
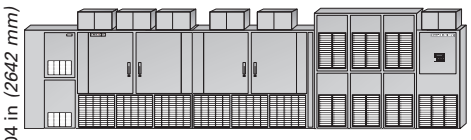
| | | 2000 Series 2300 Volts Out | | 3000 Series 3300 Volts Out | | Weight lbs. (kg) |
|---|---|---|---|---|---|---|
| | | Motor Shaft hp (kW) | Output Amps $I_{Phase}AC$ | Motor Shaft hp (kW) | Output Amps $I_{Phase}AC$ | |
|  104 in *(2642 mm)* 48 in *(1220 mm)* 48 in *(1220 mm)* | Frame A2 | 450 (336) | 97 | – | – | 5,000 - 8,300 (2,270-3,765) |
|  104 in *(2642mm)* 44 in *(1118 mm)* 74 in *(1880 mm)* | Frame B2 (2000 Series) Frame 0 (3000 Series) | 600 (448) | 129 | 475 (354) | 74 | |
| | | 900 (671) | 193 | 635 (474) | 99 | |
| | | – | – | 715 (533) | 112 | |
| | | | | 790 (589) | 124* | |
|  104 in *(2642 mm)* 44 in *(1118 mm)* 122 in *(3099 mm)* | Frame D2 (2000 Series) Frame 1 (3000 Series) | 1,000 (746) | 215 | 790 (589) | 124 | 9,000 - 12,000 (4,082 - 5,534) |
| | | 1,250 (933) | 269 | 990 (738) | 155 | |
| | | 1,500 (1,119) | 322 | 1,390 (1,037) | 217 | |
| | | 1,750 (1,306) | 376 | 1,585 (1,182) | 248* | |
|  104 in *(2642 mm)* 50 in *(1257 mm)* 164 in *(4166 mm)* | Frame 2 | – | – | 1,785 (1,332) | 279 | 15,000 - 18,000 (6,823-8,188) |
| | | | | 1,980 (1,477) | 310 | |
|  104 in *(2642mm)* 50 in *(1257 mm)* 174 in *(4420 mm)* | Frame 3 | – | – | 2,380 (1,775) | 372 | 14,000 - 22,500 (6,368 - 10,325) |
| | | | | 2,775 (2,070) | 434 | |
|  104 in *(2642 mm)* 50 in *(1257 mm)* 222 in *(5639 mm)* | Frame 4 | 2,500 (1,865) | 537 | 3,170 (2,365) | 496 | 21,000 - 32,500 (9,552 - 14,784 |
| | | 3,000 (2,238) | 644 | 3,965 (2,958) | 620 | |
| | | – | – | 4,360 (3,253) | 682 | |
| | | | | 4,750 (3,544) | 742* | |

*110% OL, 60 seconds

**Notes**

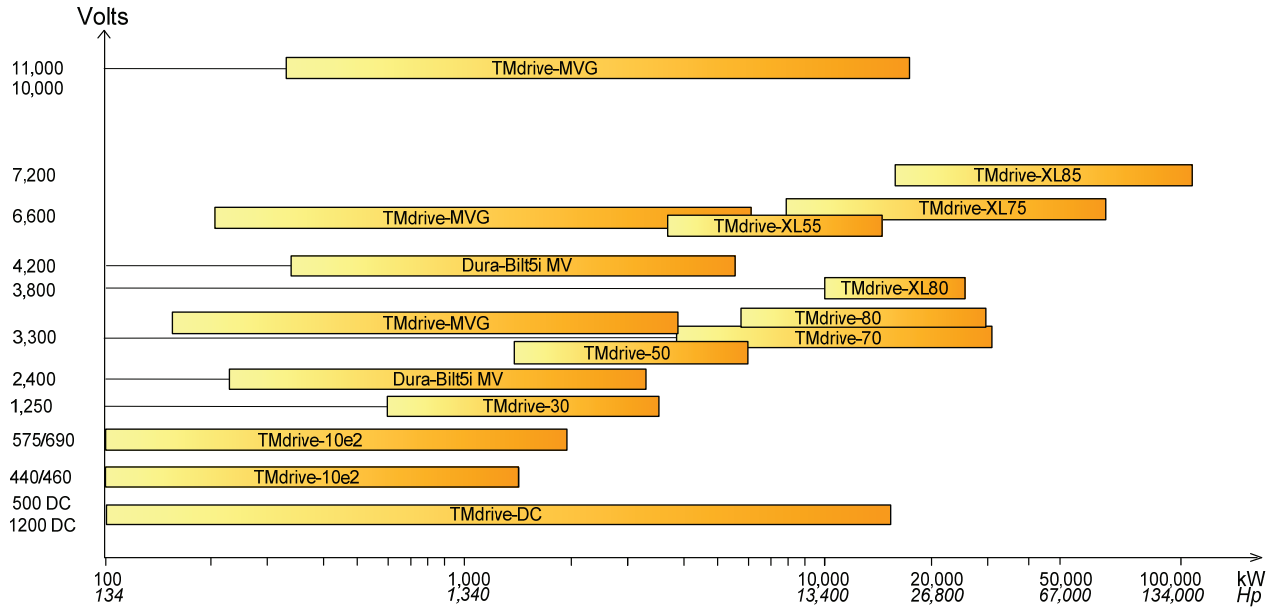
1. $kVA_{Inverter}$ = ($Power_{Mtr\ Shaft}$) / (Mtr PF x Mtr Eff)
   $I_{Phase}$ = ($kVA_{Inverter}$) x (1000) / (1.732) x ($V_{Mtr\ Line\ to\ Line}$)
   - Mtr PF = 0.87, Mtr Eff = 0.94, ambient temperature is 32˚F-104˚F (0˚C-40˚C).
   - Ratings based on a variable torque load (industrial fans and pumps).
   - For constant torque load applications, a de-rate factor should be applied. Consult the TMEIC Application Center.
   - Altitude above sea level is 0-3300 ft (0-1000 m).
2. An optional bypass cabinet can be integrated into the line up:
   - For applications up to 2700 hp, add 30 in (762 mm) in width.
   - For applications greater than 2700 hp, add 72 in (1829 mm) in width.
   - Bypass cabinet mounts to left of drive for frames 0 and 1, to the right on frames 2, 3, and 4.
3. Typically 24 in (610 mm) above the cabinets should be allocated for air flow. Special cooling arrangements are available. No rear access is required.
4. Both incoming power cabling and motor cabling can be either top or bottom entry with no additional cabinets.
5. This table presents only a representative sample of voltages and horsepower ratings. Other options are available. Please consult the TMEIC Application Center.
6. Air is pulled in through the filters in the bottom of cabinets and vented out the top.
7. Voltage inputs above 6.9 kV are available in Frame 1 and above, and require 74" additional length.
8. Options include redundant motor cooling fans and control, cabinet space heater, bypass power/control, and dv/dt filter, HV input, sync motor output, bumpless transfer to and from utility, 50 Hz.
9. For conservative sizing of cooling equipment, use 3 kW/100 hp of output power.

# Dura-Bilt5i MV
# A Family of Medium Voltage Drives

| | | 4000 Series 4160 Volts Out | | Weight lbs. (kg) |
|---|---|---|---|---|
| | | Motor Shaft hp (kW) | Output Amps $I_{Phase}AC$ | |
|  104 in *(2642 mm)* 48 in *(1220 mm)* 48 in *(1220 mm)* | Frame A4µ | 600 (448) | 74 | 5,000 - 7,500 (2,270 - 3,411) |
|  104 in *(2642 mm)* 48 in *(1220 mm)* 60 in *(1524 mm)* | Frame A4 | 800 (599) | 99 | |
| | | 900 (671) | 112 | |
| | | 1,000 (746) | 124* | |
|  104 in *(2642 mm)* 44 in *(1102 mm)* 122 in *(3099 mm)* | Frame 1 | 1,000 (746) | 124 | 9,000 - 12,200 (4,082 - 5,534) |
| | | 1,250 (933) | 155 | |
| | | 1,750 (1,306) | 217 | |
| | | 2,000 (1,492) | 248* | |
|  104 in *(2642 mm)* 50 in *(1257 mm)* 164 in *(4166 mm)* | Frame 2 | 2,250 (1,679) | 279 | 15,000 - 18,000 (6,823 - 8,188) |
| | | 2,500 (1,865) | 310 | |
|  104 in *(2642mm)* 50 in *(1257 mm)* 174 in *(4420 mm)* | Frame 3 | 3,000 (2,238) | 372 | 14,000 - 22,500 (6,368 - 10,325) |
| | | 3,500 (2,611) | 434 | |
|  104 in *(2642 mm)* 50 in *(1257 mm)* 222 in *(5639 mm)* | Frame 4 | 4,000 (2,984) | 496 | 21,000 - 32,000 (9,552 - 14,874) |
| | | 5,000 (3,730) | 620 | |
| | | 5,500 (4,103) | 682 | |
| | | 6,000 (4,476) | 744* | |
|  104 in *(2642 mm)* 308 in *(7811 mm)* Depth = 60 in *(1524 mm)* | G4P | 7,000 (5,222) | 868 | 38,500 (17,459) |
|  104 in *(2642 mm)* 403 in *(10237 mm)* Depth = 60 in *(1524 mm)* | H4P | 8,000 (5966) | 992 | 56,800 (25,765) |
| | | 9,000 (6712) | 1116 | 60,800 (27,578) |
| | | 10,000 (7457) | 1240 | 64,800 (29,393) |

*110% OL, 60 seconds

# TMEIC AC Drives
# Offer Complete Coverage

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