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TMdrive®-70e2

Product Application Guide

Medium Voltage 3-Level IEGT System Drive

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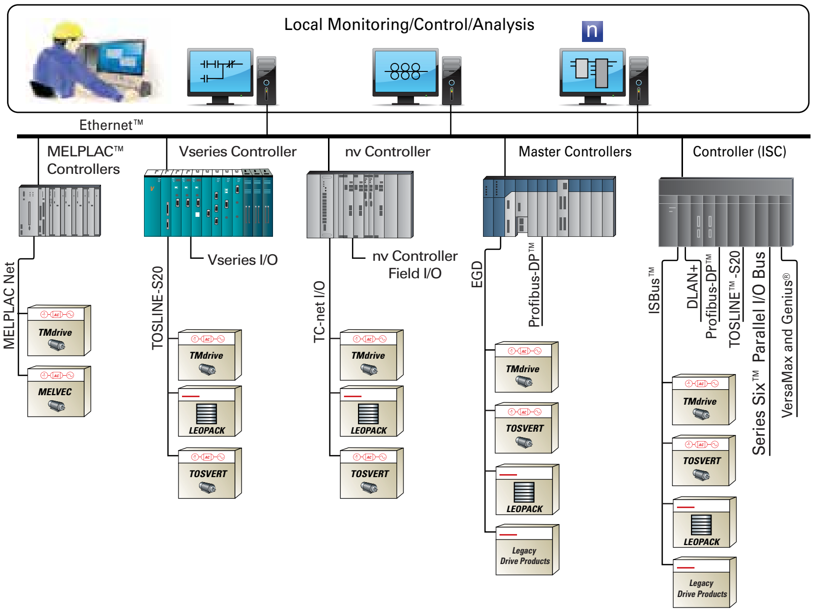
The TMdrive-70e2 is a new version of the popular TMdrive-70. The drive offers 4kV class output, and is suitable for induction or synchronous motors. The drive features:

- **Smaller size**
- **Lower weight**
- **Additional safety features**

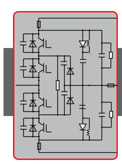


The new drive provides the same excellent benefits as the original:

- High reliability
- Regenerative converter
- Simple configuration and maintenance
- High energy efficiency and low cost of ownership

System Applications for the TMdrive-70e2 include:

- Main drives for hot strip steel mills
- Main drives for Cold Mills
- High power drives for compressors, fans, pumps, grinders and mine hoists



IEGT Technology Dramatically Lowers Cost of Ownership

The Injection Enhanced Gate Transistor (IEGT) is a breakthrough in power switch technology, providing lower cost of ownership.

Features	Benefits
• **Low Voltage Gate Drive** Given that the IEGT is a MOS structure, it can be gated (turned on/off) with ±15 V.	• **High Efficiency and Small Size** A very compact phase leg assembly is achieved with: • A reduction in snubber circuitry • Integral forward diodes • Integral clamp diodes
• **Minimal Snubber Circuitry** With the high dV/dt capability of the IEGT, there is only need for a small dc clamp snubber circuit.	• **Higher Performance** The reduction in snubber circuitry allows a higher chopping frequency, lowering the torque ripple applied to the motor and harmonics fed back into the power system.
• **High-Speed Switching** The IEGT is switched at a rate of 500 Hz in this application.	• **Motor and Power System Friendly** The high-speed switching coupled with the three-level power bridge design delivers a smooth sine wave to the motor and power system.

Bringing Reliable Control To System Applications

High-power, precision-controlled processes are ideally suited for the TMdrive-70e2 with its efficient high current IEGT power devices and control cards common to the drive family. Flexible arrangement of converter, inverter and cooling units allows for maximum power density, resulting in minimum floor space, and installation cost.

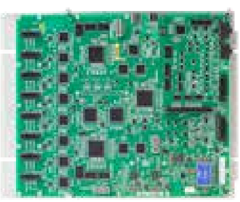
Coordinated drive systems are an integral part of numerous manufacturing processes in the metals industry. TMdrive system drives address all of these applications with a robust control platform and a common Microsoft Windows-based tool. The tool supports local and remote connectivity, and is an invaluable asset for system and process analysis.

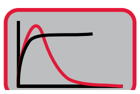
Due to its high reliability, simplicity of design and high efficiency, the TMdrive-70e2 is perfect for compressor, fan and pumping applications. It provides accurate speed control and high efficiency while eliminating the need for high maintenance mechanical flow control devices. The TMdrive-70e2 is also well suited for applications like grinding mills and mine hoists, where high overloads and impacts are a part of everyday operations.

A Look Inside the 9 MVA Drive

State-of-the-Art Technology:

- Injection Enhanced Gate Transistor **(IEGT)-based converter** and **inverter** provides power to the process at near unity power factor with minimum harmonic distortion
- **Water-cooling technology** for the power bridge reduces the footprint of the equipment saving valuable space in your factory
- **Modular design** for power bridge minimizes the time required for any maintenance activities

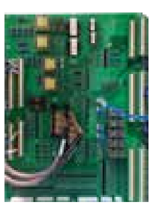


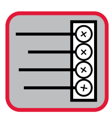


Control Functions

Each inverter and regenerative converter shares a common set of control boards. The primary control board performs several functions:
- Speed and torque regulation
- Sequencing
- I/O mapping
- Diagnostic data gathering

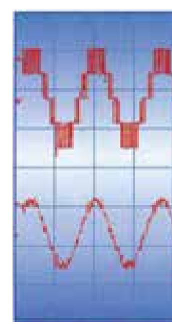
A mounting bracket is provided for an optional LAN interface board.

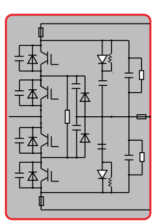




Interface Board

The interface board supports encoder or resolver, 24 V dc I/O and analog I/O. All I/O are terminated to a two-piece modular terminal block for ease of maintenance.



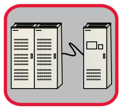


IEGT Three-Level Phase Leg Assembly

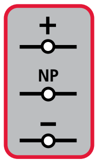
The drive has a total of six identical Injection Enhanced Gate Transistor (IEGT) phase leg assemblies in the converter and inverter.

The modular draw-out assembly includes:
- Four IEGT power semiconductors with integrated flyback diodes
- Neutral-point clamp diodes
- Water-cooled piping assembly with quick disconnect fittings
- IEGT gate driver circuit board
- Feedback control circuitry
- dc clamp snubber

Inverter Front View

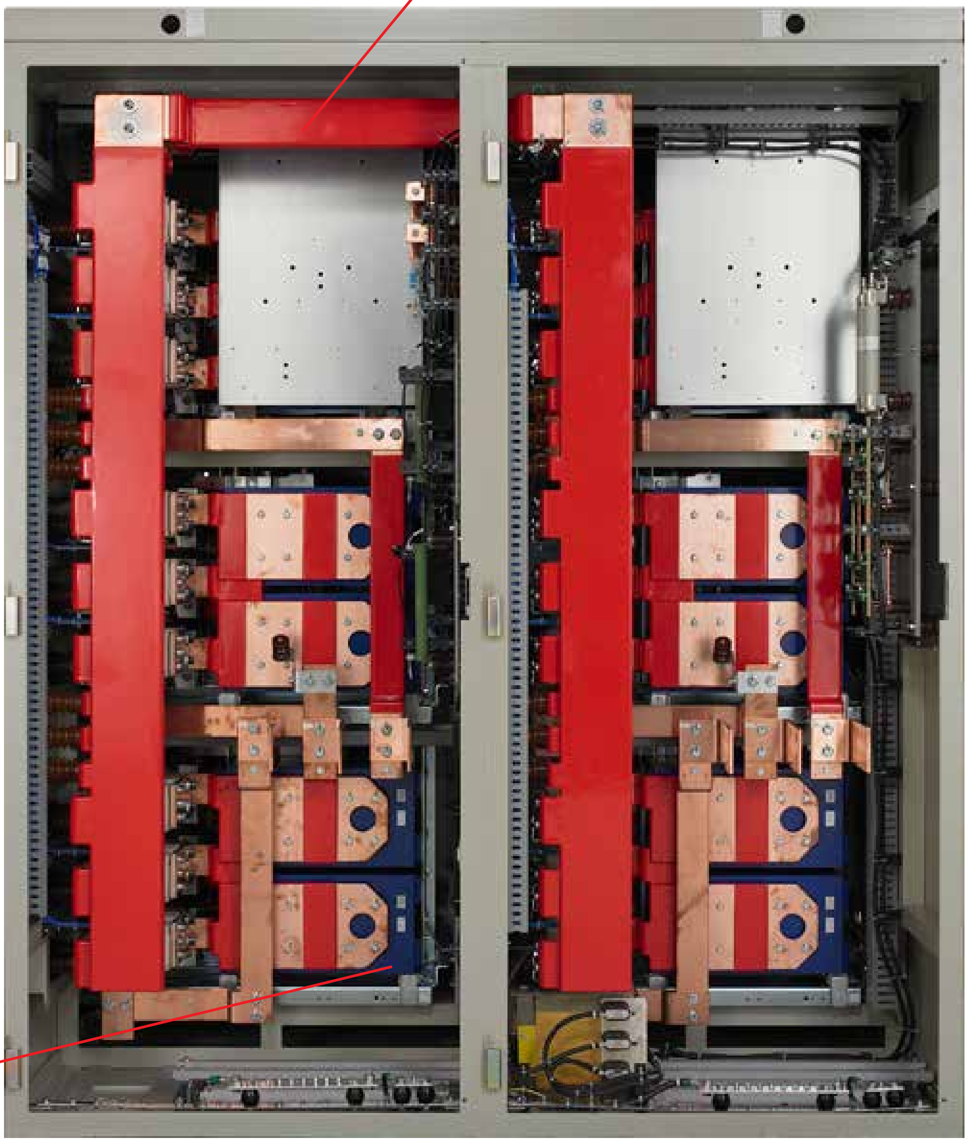


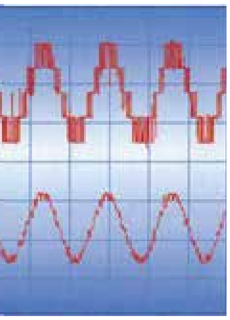
Optional Remote Control
Modular construction allows the power converter and control cabinets to be installed up to 150 m (500 ft) apart. This optimizes the use of space in your equipment room.

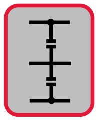


dc Bus
The converter generates dc power for the inverter. The inverter then creates variable frequency ac power to control the induction or synchronous motor. The dc power between the converter and inverter is conveyed on a solid copper bus behind the phase leg assemblies in both cabinets. For common bus systems this bus is extended to adjacent cases.

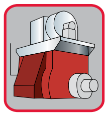
Inverter Back View **Converter Back View**



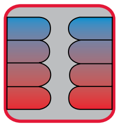




Main Capacitors
Film capacitors provide longer life, smaller size, and less weight.



Main Power
3-Phase motor and transformer connections are made in the rear. Both top and bottom are supported.

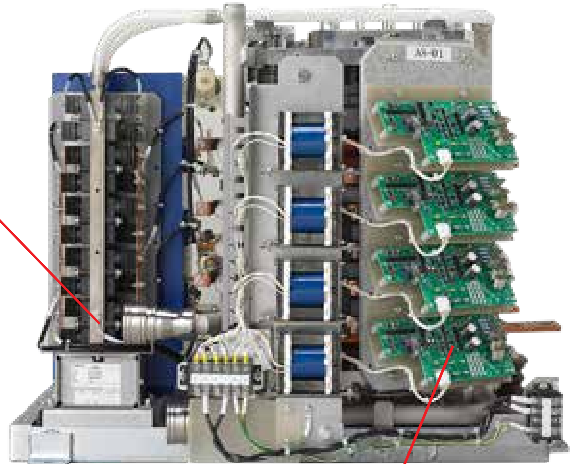


Cooling Water Interface
150 mm JIS-10K50A fittings are provided for connecting cooling water for de-ionized cooling loop.

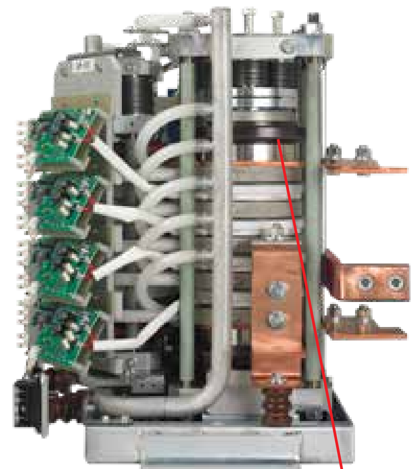
Regenerative Systems

Three-Level Phase Leg Assembly for 9 MVA Converter and Inverter

Quick disconnect fittings for the cooling system reduces mean time to repair



front view



side view

dc clamp snubber circuit absorbs the energy generated in turning off the IEGTs

Compact gate driver assemblies due to low power switching requirements of the IEGT devices

IEGT devices with integral forward and clamp diodes allow a very compact phase leg stack, reducing the footprint versus previous technology.

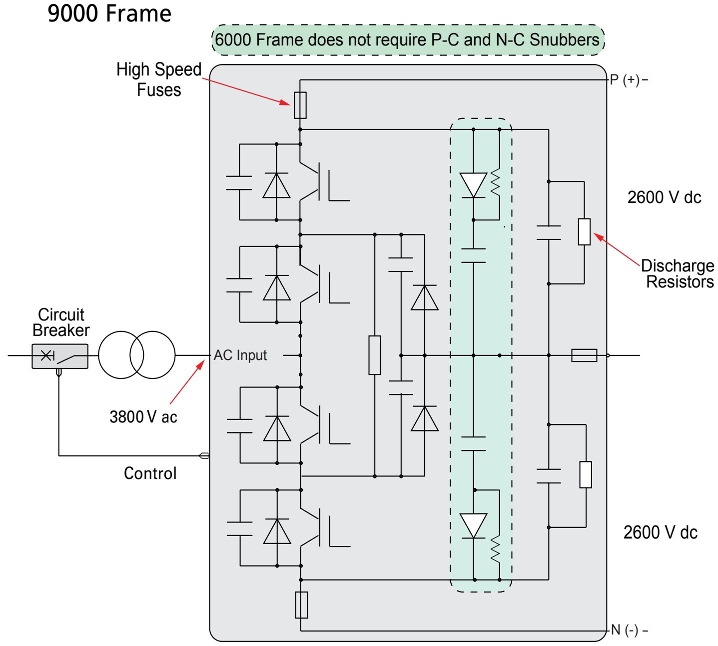
(Note: the 6 MVA stack is completely different.)

Flexible Topologies To Match Your Needs

AC DC

TMdrive–P70e2 Regenerative IEGT Converter

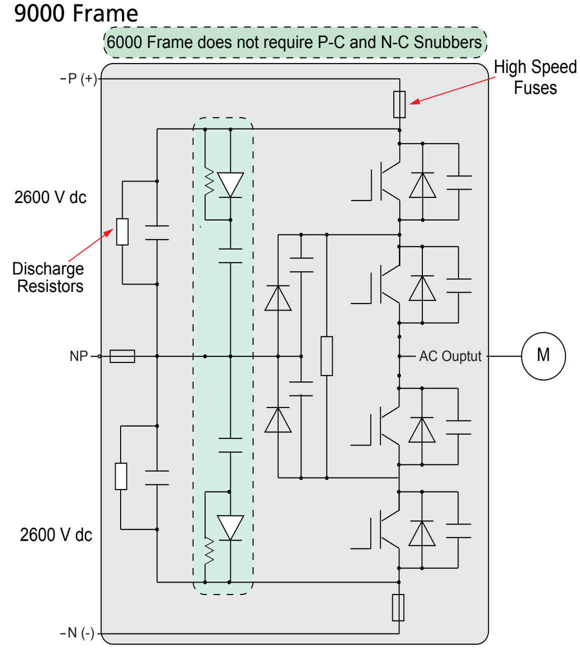
6000 Frame
9000 Frame



DC AC

TMdrive–70e2 IEGT Inverter

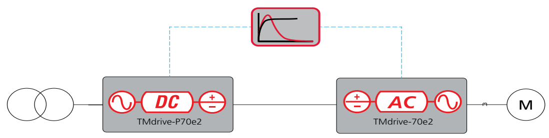
6000 Frame
9000 Frame



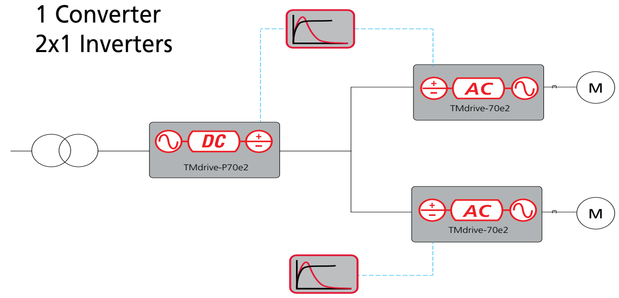
Flexible Topologies To Match Your Needs

Configuration Options

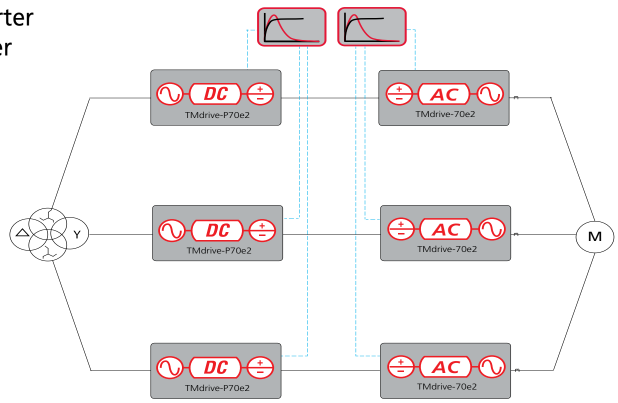
1 Converter
1 Inverter



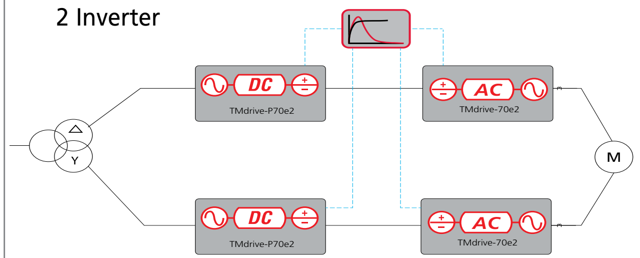
1 Converter
2x1 Inverters



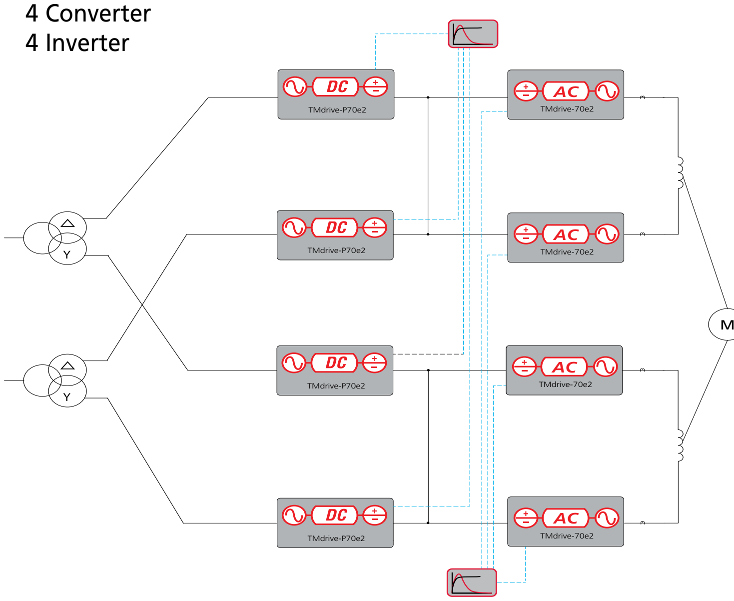
3 Converter
3 Inverter



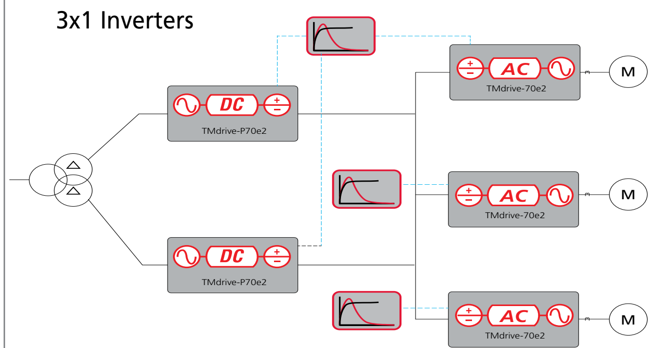
2 Converter
2 Inverter

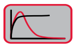


4 Converter
4 Inverter



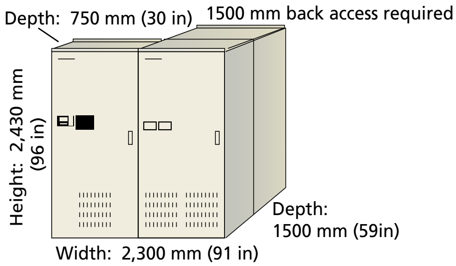
2 Converter
3x1 Inverters

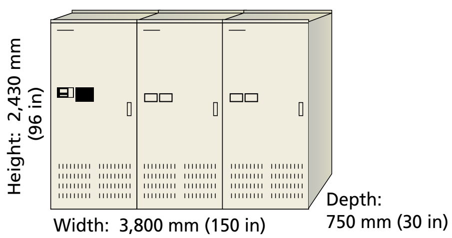


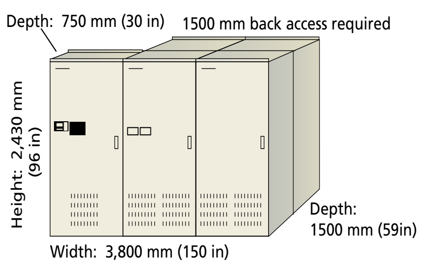


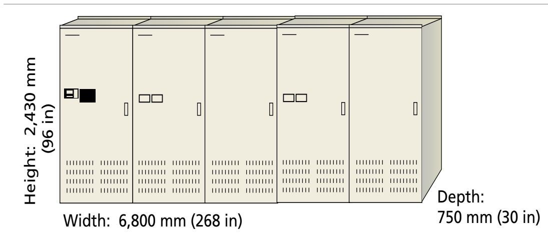
Control Cabinet

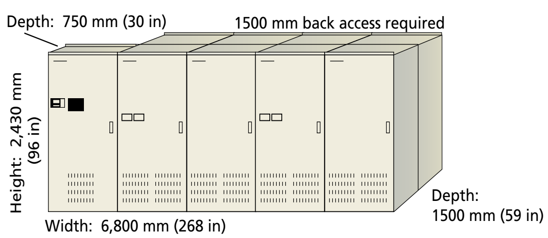
A Variety of Frames - 6 MVA

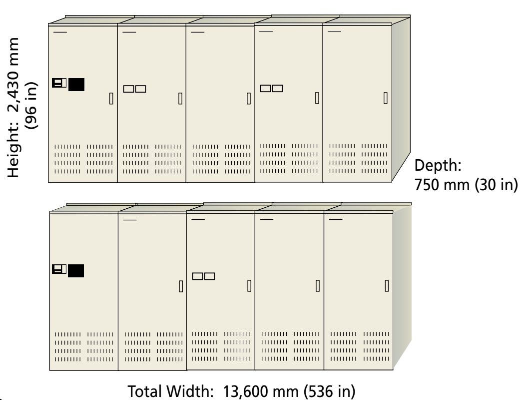






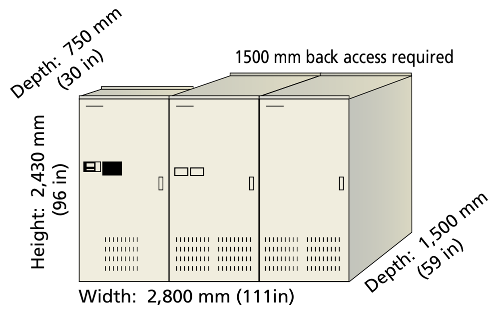
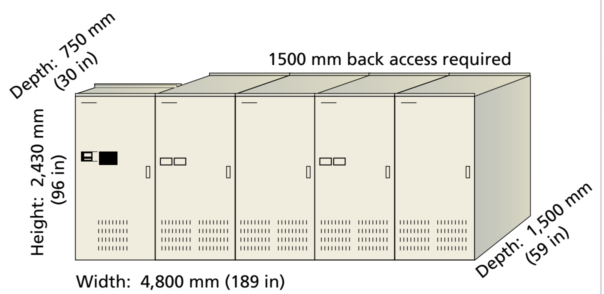
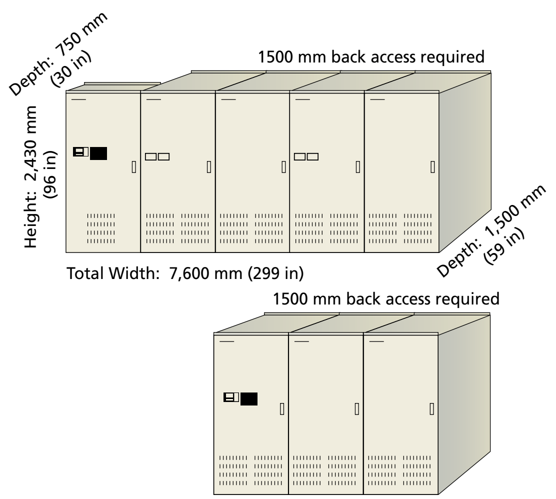
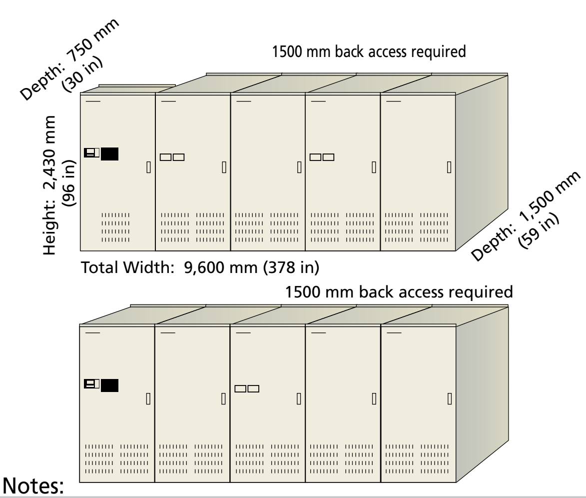






Banks	Frame (kVA)	Losses to Air (kW)	Losses to Water (kW)	Weight kg (lbs)	Control Power kVA	Motor Current A ac	Allowable Overload %
1	6,000	5	62	3,900 *(8,850)*	3.0	950	150
						814	175
						713	200
						633	225
						570	250
2	12,000	10	124	7,800 *(17,160)*	6.0	1900	150
						1628	175
						1426	200
						1266	225
						1140	250
4	24,000	20	248	15,600 *(34,320)*	12.0	3800	150
						3256	175
						2852	200
						2532	225
						2280	250

9 MVA

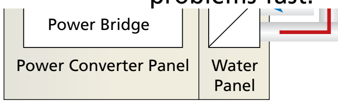
	Banks	Frame (kVA)	Losses to Air (kW)	Losses to Water (kW)	Weight kg (lbs)	Control Power kVA	Motor Current A ac	Allowable Overload %
	1	9,000	10	95	4080 *(8976)*	3.0	1430	150
							1226	175
							1073	200
							953	225
							858	250
	2	18,000	20	190	7,880 *(17,336)*	6.0	2860	150
							2452	175
							2146	200
							1906	225
							1716	250
	3	27,000	30	285	11,960 *(26,312)*	12.0	4290	150
							3678	175
							3219	200
							2859	225
							2574	250
	4	36,000	40	380	15,760 *(34,672)*	12.0	5720	150
							4904	175
							4292	200
							3812	225
							3432	250

Notes:

1. Front and rear access doors: 1000 mm overhead clearance and 1500 mm front and rear access clearance recommended. Frame 6000 does not require rear access when configured in end to end arrangement.
2. Bottom cable entry is standard, top is optional.

Water Conditioning Equipment

Water conditioning control panel continuously monitors the status of the water system. Separate fault indications help find and fix problems fast.



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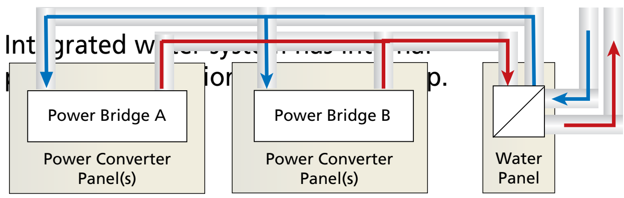


Separate type cooling has field-installed plumbing for de-ionized cooling loop.

Water to water heat exchanger keeps the de-ionized system isolated from the plant water supply.

Surge tank absorbs water during pump transients and indicates the internal cooling loop water level.

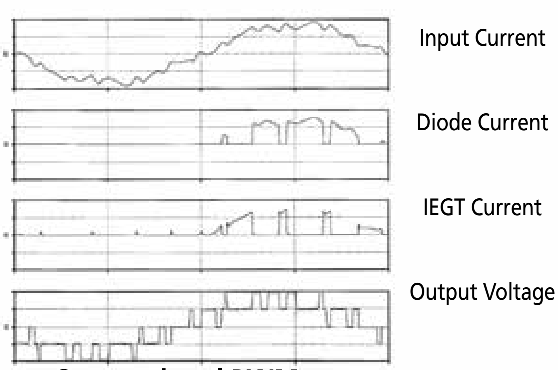
De-ionizer removes contaminants for the internal cooling loop.

Redundant pumps keep the system running even if one pump fails

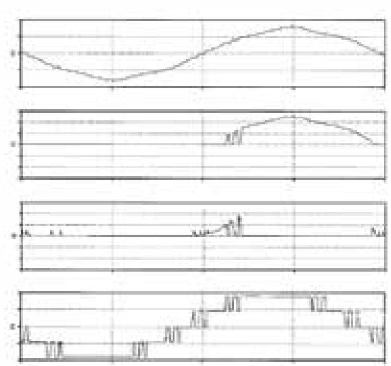
Type	Capacity	Width mm (in)	Depth mm (in)	Height mm (in)	Weight kg (lbs)	kVA	Notes (for 9 MVA drive)
Integrated with Lineup	134 kW	1200 (48)	1440 (56)	2375 (94)	1600 (3527)	5	Capacity for one converter/inverter, (1 bank) plant water required: 300 l/min (80 gal/min)
Separate Cabinet	268 kW	1200 (48)	1590 (62)	2375 (94)	1700 (3638)	10	Capacity for two converters/inverters, (2 bank) Plant water required: 600 l/min (160 gal/min)
Separate Cabinet	536 kW	3000 (118)	2000 (79)	2500 (99)	2500 (5500)	15	Plant water required: 1200 l/min (4 bank) (320 gal/min)
Separate Cabinet	804 kW	4300 (170)	2000 (79)	2500 (99)	4300 (9480)	25	Plant water required: 1800 l/min (6 bank) (475 gal/min)

Advanced PWM Technology

Advanced PWM control brings enhanced efficiency and reduced harmonics to TMdrive-70e2 systems. Fixed pulse pattern gate control uses optimum gating sequences to almost eliminate switching losses in the IEGT device. Gating sequences are pre-computed for the control rather than computed at runtime. The result is performance that reduces losses and harmonics.



Conventional PWM

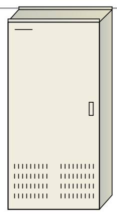
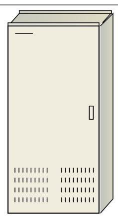


Fixed Pulse Pattern Control

Synchronous Motor Exciter

Synchronous Motor Field Exciter

- **Microprocessor-based fully digital control**
- **One direction, full wave bridge thyristor rectification**
- **Current control following main speed/ torque regulator commands**
- **Air cooled**
- **Maintenance from front**
- **Bottom cable entry**
- **Required free-standing indoor cubicle, totally enclosed IP20**

	Frame	Weight kg *(lbs)*	Input Voltage*	Current Adc	60 second overload
 2430 mm *(96 in)* 800 mm *(32 in)* Depth: 750 mm *(30 in)*	1200A	400 *(880)*	Max: 600Vrms ± 10% 50/60 ± 2Hz	1180 1040 930 840 760	150 175 200 225 250
 2430 mm *(96 in)* 1200 mm *(47 in)* Depth: 750 mm *(30 in)*	2400A	600 *(1320)*	Max: 750Vrms ± 10% 50/60 ± 2Hz	2400 2260 2040 1850 1700	150 175 200 225 250)

* Select depending on forcing voltage.

Frame 1200 Field Supply

Enhanced Converter Technology

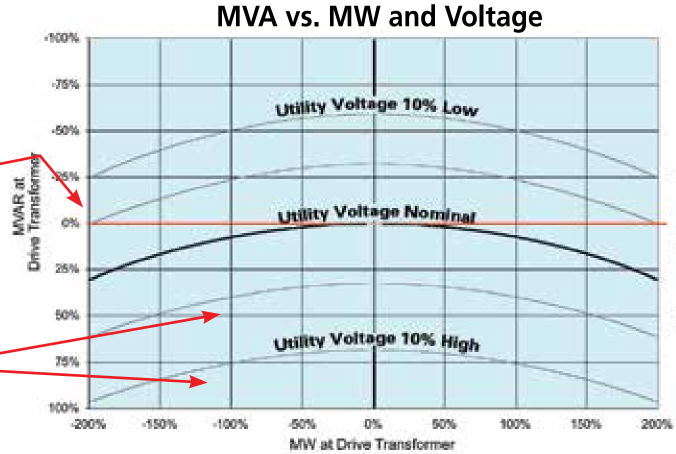
TMdrive-P70e2 VAR Control

The TMdrive-P70e2 converter can be configured in two modes, providing VAR Control within the limits of its current capacity.

One mode is the conventional PWM type normally set to hold unity power factor for all load conditions. (Shown in red)

Another mode is the Fixed Pulse Pattern type, providing voltage stability, improved harmonics and efficiency. The Fixed Pulse Pattern mode stabilizes line voltage by providing system VARs when line voltage is low and drawing VARs from the system when the voltage is high. By convention, VARs from the system are (+) and cause the line voltage to drop while VARs from the converter are (-) and cause the line voltage to rise. The relationship of line voltage, loads MW and converter MVAR is shown by the blue voltage lines depending on the measured line voltage.

MVA vs. MW and Voltage



Application Examples

Applying the TMdrive-70e2 Starts With the Motor Design

Consideration must be given to motor design when applying the TMdrive-70e2. A primary constraint is the motor terminal voltage. It is important that the motor terminal voltage does not exceed 3650 Vac under any operating condition. Reserving voltage margin correctly is critical to success. Detailed motor design data is needed for correct application.

OL_V Overload derate. The rated motor voltage over the terminal voltage of the motor at maximum applied overload. Motors with no overload use 1.0.

RP_V Reduction in maximum voltage due to the dc bus ripple of the drive at low frequencies. If the base frequency is below 5 Hz then this derate is 0.97, otherwise it is 1.0.

ST_V Field forcing margin needed when applying synchronous motors. Apply 0.94 for synchronous motor systems.

SP_V Speed margin. For motors that run above base speed this is the ratio of the terminal voltage at base speed over the terminal voltage at top speed under maximum overload at each point. Other motors use 1.0.

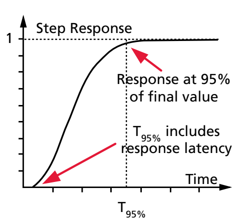
Maximum Rated Motor Voltage = 3650 x OL_V x RP_V x ST_V x SP_V

Experience has shown that the following maximum rated motor voltages apply based on the type of motor and the application.

Induction (Maximum Voltage at max OL and top speed)	Synchronous Maximum Rated Motor Volts	Rated Motor Frequency	Overload Requirement	Example Application
3650	3500	60 Hz	100%	Pump or Fan
3500	3400	30 Hz	200%	Mine Hoist
3400	3300	5 Hz	225%	Mill Stand

TMdrive-70e2 Notes

1. Allocate a minimum of 1000 mm *(40 in)* above cabinet for fan maintenance.
2. Power rating data assumes ambient temperature of 5-40° C *(41-104° F)*, altitude up to 1000 m *(3280 ft)* above sea level.
3. The specified current ratings are continuous to which the indicated overload may be applied for a maximum of 60 seconds.
4. Each cabinet requires 3-phase control power.
5. For high performance torque regulation, a temperature sensor is mounted in the motor (induction motor only).
6. All TMdrive-70e2 cabinets require 1500 mm *(60 in)* front access for connections and maintenance.
7. Water connections for separate type cooling systems are located near the floor in the rear of power converter cabinets. The flange is 150 mm JIS-10K50A. Stainless piping is required for plumbing of the de-ionized loop. Secondary cooling water temperature supplied by customer 10-32° C (50-89° F).



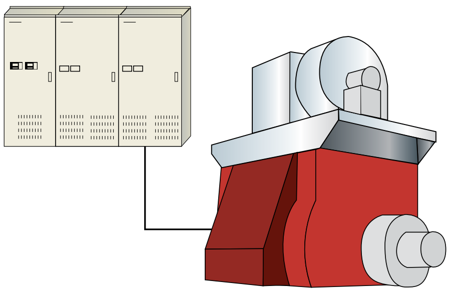
Response = $3/T_{95\%}$ (radians/s)

8. Speed and current regulator responses are computed per the adjacent figure in radians/s. Speed regulator responses shown are maximum available. Actual response will be limited by drive train mechanical conditions. Accuracy and linearity specifications shown are as measured under controlled conditions in our lab and while typical may not be achievable in all systems.
9. dc Bus bar included in lineups is rated for one inverter only. For common bus systems, converters and inverters are arranged so that this limitation is not exceeded.
10. When output or input reactors are used to parallel systems then the dc Buses of those systems must be connected together.
11. Systems that share a common dc Bus must have the same winding configuration for their converter transformer secondaries.
12. Field supply enclosures are typically installed directly behind control enclosures within the lineup.
13. TMdrive-70e2 converters require a minimum of 15% total input impedence.
14. Systems with a base frequency below 5 Hz may require additional 800 mm *(32 in)* capacitor panels for each dc link, 1800 kg weight.

Inverter Example

When specifying an inverter, start from the process requirements and work through the motor to the inverter. The following example illustrates this process.

1 Define process requirements.



kW_{Shaft} = 6500 kW *(8700 hp)*
500 rpm

The motor delivers constant torque from zero to base speed of 500 rpm and 7500 kW *(10,000 hp)*.

Duty cycle requires 150% for 10 sec. but has rms duty cycle of 7500 kW *(10,000 hp)*

2 Select motor based on process requirements and compute required inverter kVA.

- 7500 kW *(10,000 hp)*
- 500 rpm, 3300 V
- Efficiency = 0.965
- Power factor = 1.00
- Service factor = 1.0
- Synchronous

3 Compute continuous current requirements for the inverter based on the selected motor.

$$I_{ac\ Inverter} = \frac{kW_{Shaft} \times 1000 \times SF_{Mtr}}{\sqrt{3} \times V_{Motor\ rated\ voltage} \times Eff_{Mtr} \times PF_{Mtr}}$$

$$= \frac{7500 \times 1000 \times 1.0}{\sqrt{3} \times 3300\ V \times 0.965 \times 1.0}$$

$$= 1360 \text{ amps}$$

4 Select inverter based on continuous current and overload requirements.

Scan the 150% entries in the inverter tables for a frame where the continuous current rating exceeds 1360 amps. The **9000 frame** meets this criterion (**1430 amps**) and is appropriate for this application.

Current A ac	Allowable Overload %
1430	150
1226	175
1072	200
953	225
858	250

Regenerative Converter (TMdrive-70e2) Example

When specifying a converter, start from the process requirements and work through the motor to the inverter, and then the associated converter. The following example illustrates this process (continuation of inverter application example from above):

1 Compute kW requirements into the inverter. It is assumed that the converter is dedicated to the inverter specified in the application example above. It is also assumed that the converter is controlled to unity power factor.

$$kW_{ac} = \frac{kW_{Shaft}}{Eff_{Mtr}}$$

$$= \frac{7500\ kW}{0.965}$$

$$= 7762\ kW$$

2 Compute continuous ac current requirement of the converter based on its power requirements.

$$I_{ac\ Converter} = \frac{kW_{ac} \times 1000}{\sqrt{3} \times V_{Converter\ line\text{-}to\text{-}line\ voltage} \times Eff_{drive}}$$

$$= \frac{7762\ kW \times 1000}{\sqrt{3} \times 3800\ V \times 0.985}$$

$$= 1198 \text{ amps}$$

Note: For sizing systems with peak powers in regenerative mode, a different equation is used to compute power requirements.

$$kW_{ac} = kW_{Shaft} \times Eff_{Mtr}$$

3 Scan the regenerative converter table for entries that exceed your overload (150%), time **(60 sec)** and continuous current requirements **(1192 amps)**. In this case the **9000 frame** TMdrive-P70e2 meets the requirement and is appropriate for this application.

Current A ac	Overload – Time
1430	150% – 60s
1226	175% – 60s
1072	200% – 60s
953	225% – 60s
854	250% – 60s

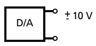
A Common Control to Reduce Cost of Ownership

Instrumentation Interface

Configuration

- Direct Ethernet connection of TMdrive-Navigator to the drive
- Drive Navigator connection to the drive using TC-net via the nv controller

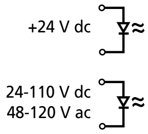
Meter Outputs



- Quantity 5 configurable, ±10 V,
  10-bit resolution

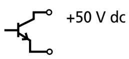
I/O Interface

Digital Inputs



- Opto-coupled 10mA
- Quantity 7 configurable mapping
- Quantity 2 dedicated mapping
- Optional Quantity 6 configurable mapping

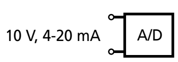
Digital Outputs



<Inverter Signals>
- Open collector 50mA
- Quantity 5 user defined
- Onboard relay (Dry C Contact)
- Quantity 5 user defined
- Optional Quantity 6 user defined

<Converter Signals>
- Open collector 50mA
- Quantity 7 user defined
- Onboard relay (Dry C Contact)
- Quantity 3 user defined
- Optional Quantity 6 user defined

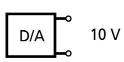
Analog Inputs



<Inverter Signals>
- Quantity 2 ±10V or 4-20mA
- Differential 8kΩ input impedance
- 12-bit resolution
- Optional Quantity 2 ±10V

<Converter Signals>
- Optional Quantity 1 ±10V

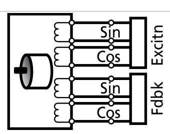
Analog Outputs



<Inverter Signals>
- Quantity 4 ±10V, 1mA max
- User defined
- 12 bit resolution
- Optional Quantity 3 ±10V, 1mA max

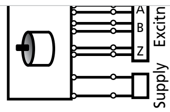
<Converter Signals>
- Quantity 4 ±10V, 1mA max
- User defined
- 12 bit resolution
- Optional Quantity 3 ±10V, 1mA max

Speed Feedback Resolver Input



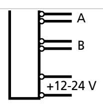
- Excitation frequency of 1 or 4 kHz
- Source for resolvers is Tamagawa: www.tamagawa-seiki.co.jp

(Induction Motor Only)
Speed Feedback Encoder Input



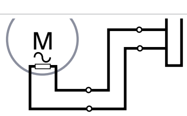
- A quad B with marker
- Maximum frequency of 100 kHz
- Differential 5 or 15 V dc
- 5 or 15 V dc at 200 mA supply

Speed Tach Follower Output



- Maximum frequency of 100 kHz
- External 12-24 V dc at 25 mA max

Motor Temperature Feedback



- High-resolution torque motor temperature feedback
- 100 Ω positive temperature coefficient RTD or other sensor using optional signal conditioning module

Power Input/Output

Input Voltage	3800 V for Fixed Pulse Pattern type 3300 V for Carrier Comparison type
Input Voltage Variation	± 5% for fixed pulse pattern +5/-10% for conventional PWM, continuous operation below nominal requires derate
Input Frequency	50/60 Hz
Input Chopping	450/540 Hz
Input Harmonics Compliant	TMdrive-70e2 – IEEE 519
Control Power	Control and Blowers 180-220 Vac. 50 Hz 3-Phase 198-242 Vac, 60 Hz 3-Phase
	Pumps and Precharge 380-460 Vac, 50/60 Hz 3-Phase
PLL Supply	110/110 V 50 or 60 Hz 3 Phase, 5 VA
Displacement Power Factor	0.98 TMdrive-P70e2 (see page 11)
Output Frequency	0-75 Hz
Output Chopping Frequency	512 Hz
Output Voltage for induction motors	3,650 V ac
Efficiency	99% at rated load

Motor Control

With Speed Sensor (Resolver or Encoder)

Speed regulator accuracy: +/- 0.01%
Maximum speed response: 60 rad/sec (without coupling)
Torque linearity: +/- 10% Synchronous motors
Torque linearity: +/- 3% with temperature sensor } Induction Motor
+/- 10% without temperature sensor } Induction Motor
Maximum Torque current response: 600 rad/sec
Torque range: 0-400% of rated motor torque
Maximum flux control range: 20%-100%

Without Speed Sensor (Induction Motor Only)

Speed regulator accuracy: +/- 0.1% with temperature sensor
+/- 0.2% without temperature sensor
(Using 1% slip motor at rated flux)
Maximum speed regulator response: 20 rad/sec
Minimum continuous speed: 3%
Torque linearity: +/-10%
Maximum Torque current response: 600 rad/sec
Torque range: 0-150% of rated motor torque
Maximum flux control range: 75%-100%

Operator Interfaces

Mechanical (Inverters & Converters)

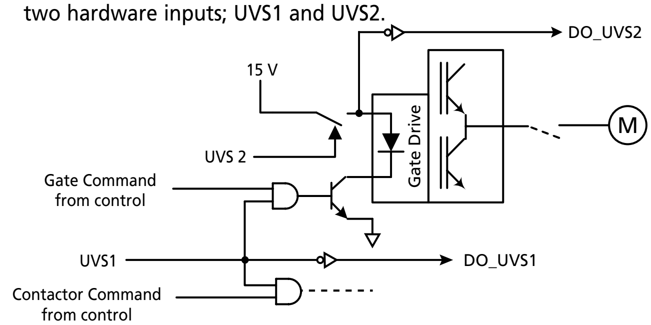
Enclosure	IP 20 (NEMA 1); IP43 option
Cable Entrance	Bottom, top is optional
Wire Colors	Per CSA/UL and CI
Short Circuit Ratings	100 kA for ac and dc buswork 25 kA for control power
Acoustic Noise	66-68 dB @ 150% OL 1 m from cabinet in all directions 1.5 m in height above floor

Environmental (Inverters & Converters)

Operating Air Temp.	5° to 40° C (41 to 104° F) at rated load 5° to 50°C (41 to 122° F) with derating
Storage Temperature	-20° to 55°C (-13 to 131° F)
Humidity	5 to 85% relative humidity Non-condensing
Altitude	0 to 1000 m above sea level
Vibration	10-50 Hz, <0.5 G
Operating Water Temperature	10° C - 32° C at inlet 10° C - 35° C at inlet with derate Outlet temperature is inlet + 7.2° C

Safety Integrity

Safety features according to IEC 61800-5-2 (Safety Integration Level 2) is insured by independent gate command lockout via two hardware inputs; UVS1 and UVS2.



LAN Interface Options

TC-net I/O	• 8 words in/out • 10 words in/19 out option
Ethernet Global Data (EGD)	• 10 words in/out
Profibus-DP	• 10 words in/out
Modbus RTU	• 10 words in/out
ControlNet	• 10 words in/out
DeviceNet	• 4 words in, 10 words out

TOSLINE-S20 and ISBus legacy LANs can also be supported on request. *Note: 1 word = 16 bits*

Keypad (Inverters and Regenerative Converters)

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

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

Keypad

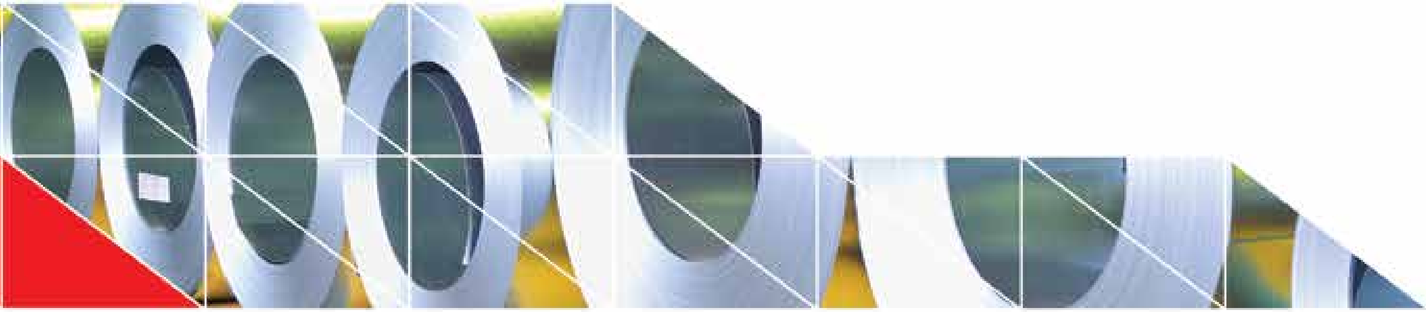
Emergency Stop Button and Circuit Breaker Operation Panel

RJ-45 Ethernet port is used for the local tool box connection

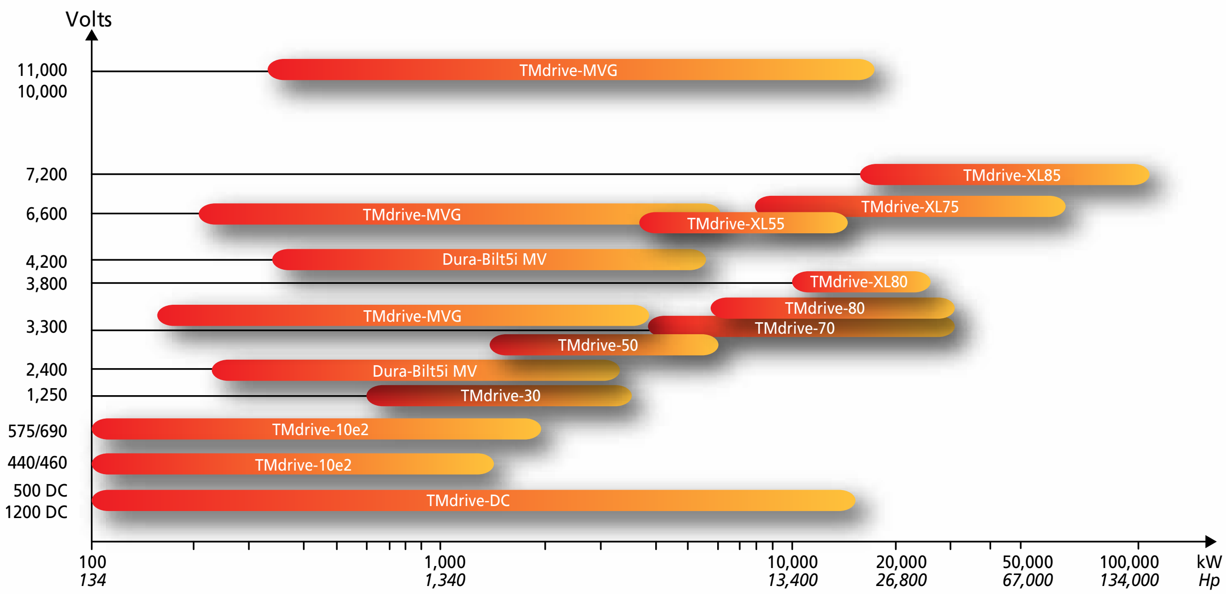
Interlock button disables the drive

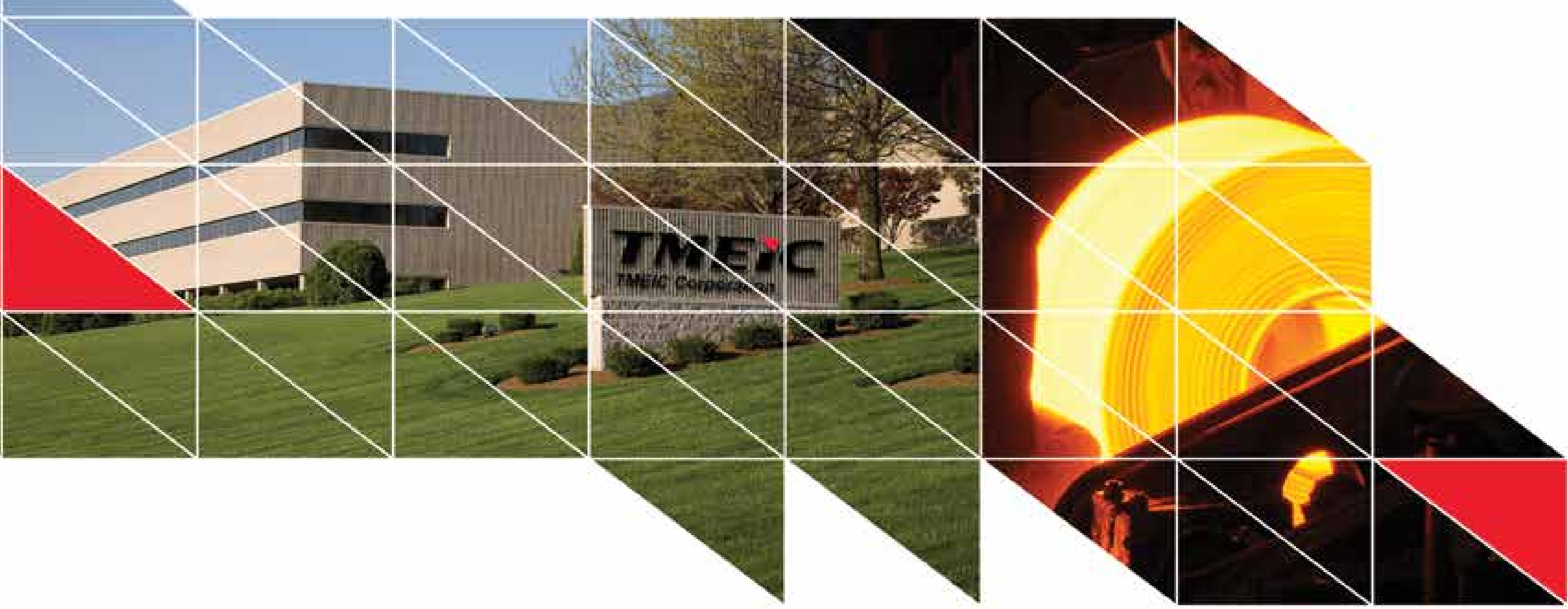
Switch to local mode and operate the equipment right from the keypad

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



TMEIC AC Drives Offer Complete Coverage





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