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We drive industry

# TOSHIBA MITSUBISHI-ELECTRIC INDUSTRIAL SYSTEMS CORPORATION


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**Safety precautions**

- For safe and correct use, be sure to read the "Handling and Operation Manual" carefully before use.


B-D056-2304-A(Hearts)

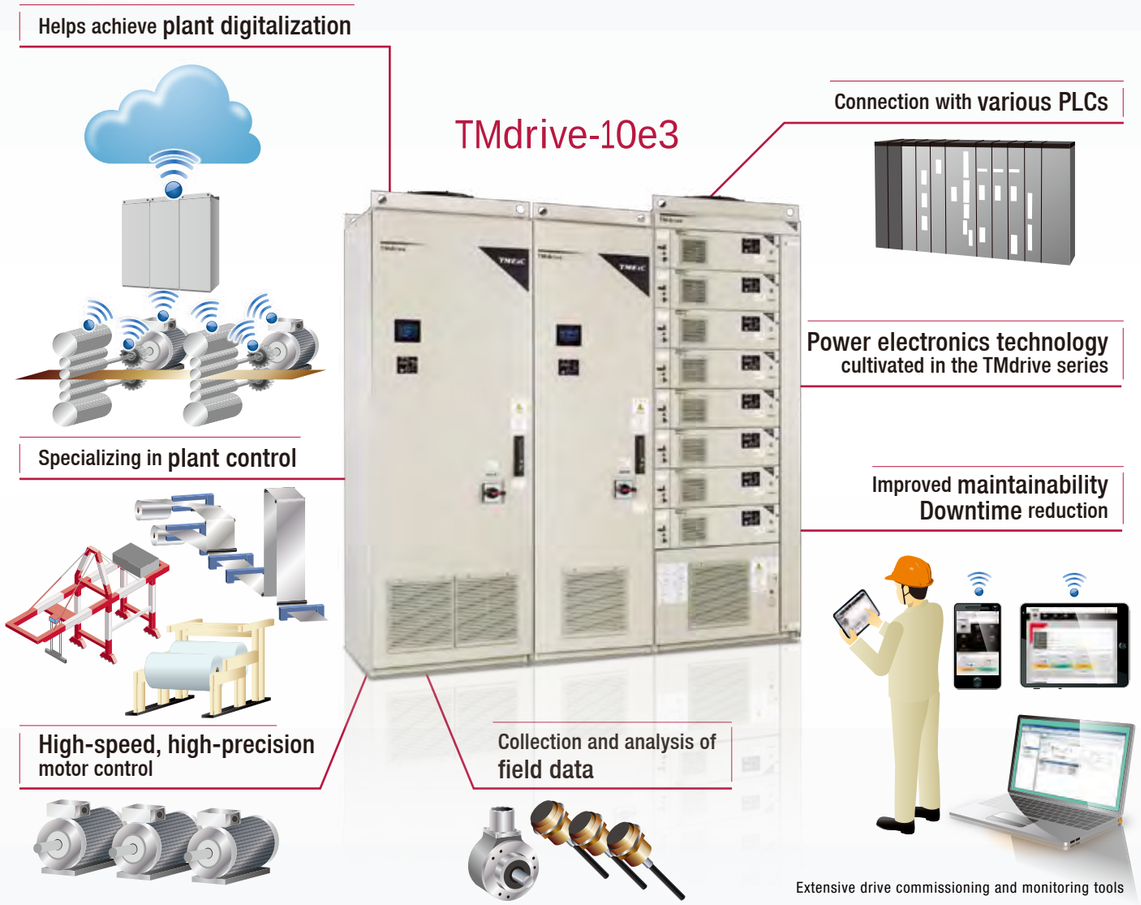

LOW VOLTAGE IGBT INVERTER / CONVERTER

# TMdrive™-10e3 series

TOSHIBA MITSUBISHI-ELECTRIC INDUSTRIAL SYSTEMS CORPORATION

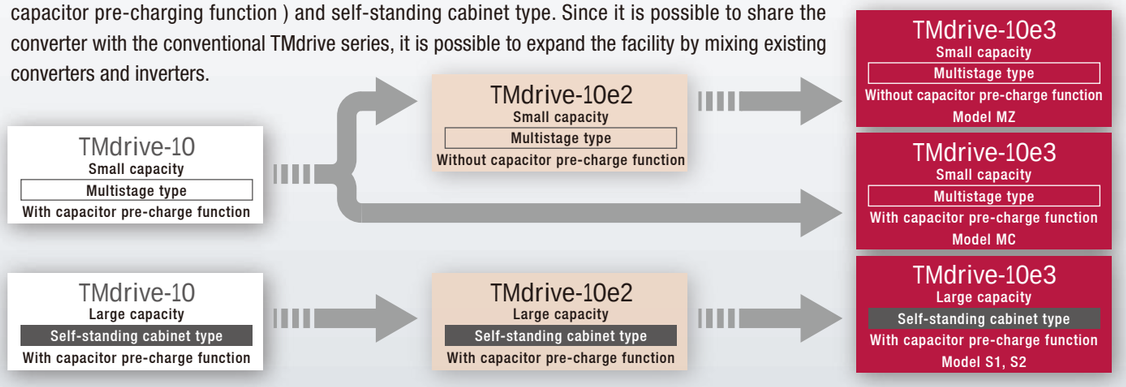
# AC adjustable speed low voltage inverter / converter electrical power drive that combines high reliability and cutting-edge technology for plant applications TMdrive™-10e3

TMdrive-10e3 utilizes the proven main circuit of the TMdrive series and implements the latest control devices. In addition to high performance as a drive equipment such as high-speed and high-precision motor control and connection with various PLCs, it has field data collection and analysis functions and expandability that satisfies the unique requirements of facilities and equipment to which the drive is applied. In addition, extensive drive commissioning and monitoring tools have improved drive maintenance and adjustment functions. TMdrive-10e3 is an AC drive specialized for controlling plants such as steel plants, paper plants, and cranes, and contributes to improved controllability, maintainability, and digitalization.




## Transition of TMdrive-10e3 Series

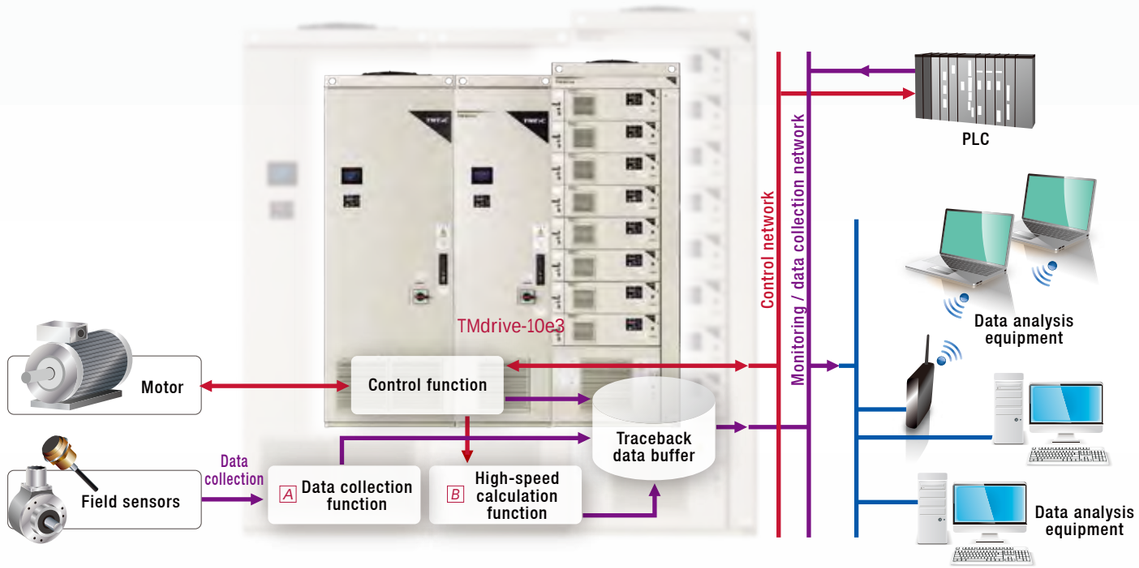
There are three types of inverter structures for TMdrive-10e3: multi-stage type ( with or without capacitor pre-charging function ) and self-standing cabinet type. Since it is possible to share the converter with the conventional TMdrive series, it is possible to expand the facility by mixing existing converters and inverters.




## Helps Achieve Plant Digitalization

### A Data collection function

Plant Digitalization can be achieved by using the data collected by TMdrive-10e3 such as motor currents, motor voltage, motor speed, self-diagnostics and field data from various sensors. TMdrive-10e3 uses extended inputs / outputs to collect field data. It can uniquely process data based on the application. It can store data temporarily using a buffer or it can store long-term history data using built-in SD card. A faster data collection and enhanced security is achieved by isolating Control Network from Diagnostic Network.



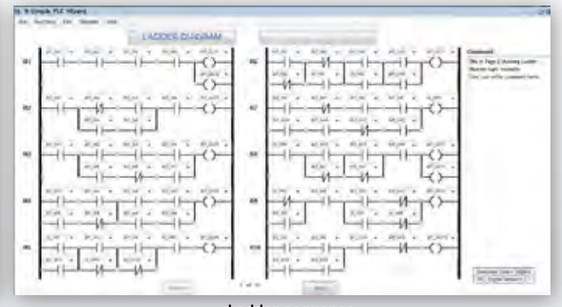

### B High-speed calculation function

The high-speed calculation function enables high-speed sampling and high-speed analysis of functions such as frequency domain analysis. TMdrive-10e3 can store high-speed data and results of high-speed calculations in a temporary buffer and it can broadcast them to external supervisory / diagnostic devices. Due to separation of Control Network from Data collection / diagnostics Network as well as of Control Function from High-Speed Analysis function, impact on CPU processing power and motor control is avoided.

## Drive Specialized for Plant Control

TMdrive-10e3 has built-in micro PLC which can be programed to add simple ladder logic functions or simple application specific functions. In addition, the number of external signal input / output points can be expanded by connecting additional I/O boards.


User-defined functions



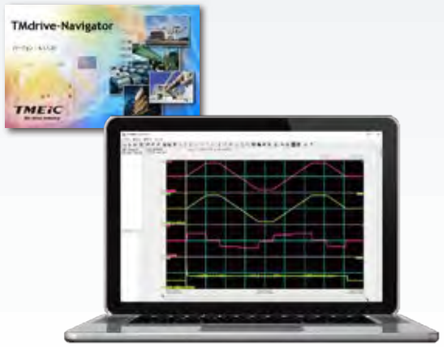

Ladder sequence

The maximum I/O points for each type: Analog input 8 ch max., analog output 8 ch max., digital input 16 ch max., digital output 16 ch max., RTD input 2 ch max.

## The Group of Tools that Improve Maintainability

### TMdrive-Navigator

TMdrive-Navigator is a world class tool that can be used to adjust and / or monitor drive parameters. In addition to individual's parameter adjustments, it is now possible to change a group of parameters specific to a function or application. It is also possible to fine tune parameters to "increase response" or "suppress vibrations" to improve motor control and process performance. In the event of a failure, TMdrive-10e3 can store Traceback data for longer duration. Number of saved Tracebacks as well as recording duration of Traceback is increased to allow enhanced diagnostics during a failure.




### TMdrive-Monitor

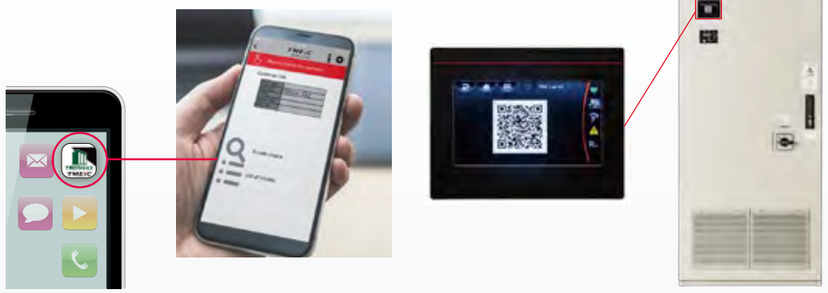
It is possible to monitor the driving status and failure information of the drive from a smartphone or tablet. Traceback data can be uploaded when a failure occurs.

Usage image

### TMdrive-Support

A QR code will be displayed on the Key Pad operation panel [1] on the drive panel. By reading the QR code with a smartphone or tablet with TMdrive-Support installed, device information such as ratings can be obtained. In addition, by reading the QR code that is displayed at the time of failure, troubleshooting for the corresponding failure will be displayed on the smartphone or tablet.

NOTE 1) Key Pad is an option.



## Downtime Reduction

### Parameter Migration

When replacing the CTR board ( main control board ) , it is possible to take over the drive information by inserting the SD card with the saved parameters into the new board.

### Preventive maintenance

TMdrive-10e3 tracks operation time of certain parts within the drive. To complement preventive maintenance, TMdrive-10e3 will announce when a particular component is approaching end of its recommended operating life.

## TMdrive-10e3 Structure

### TMdrive-10e3 Multistage Type

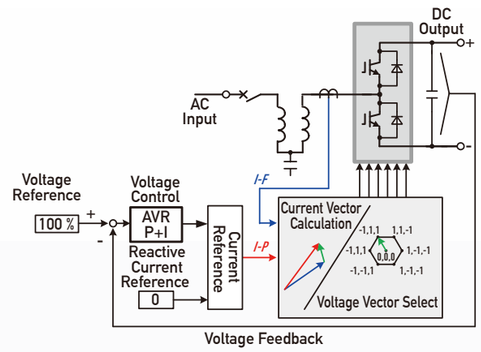
**Model MC**
**With capacitor pre-charge function**

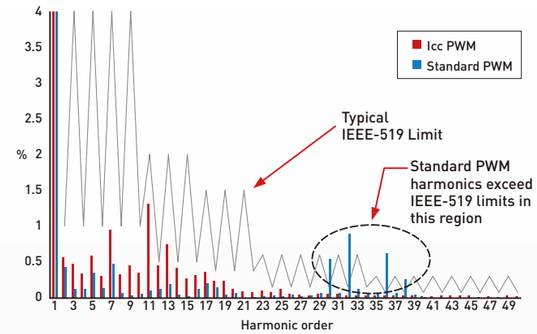
The TMdrive-10e3 multi-stage unit can be pulled out with the handle to disconnect the unit from the DC power supply. The unit can be replaced by pulling out the unit further.

### TMdrive-10e3 Self-standing Cabinet Type

The self-standing cabinet type of TMdrive-10e3 has a Standard Display on the panel surface. Four-digit display alternates between speed and current while running, or a fault code when there is an error. The disconnector ( option ) can be operated from the door surface to disconnect the inverter from the DC bus. Even if the door is opened, the main circuit is protected by Equipment Safety Covers.

## TMdrive-P10e3 Intelligent Current Control, IccPWM




**Reduced harmonics mean a simple filter can achieve IEEE-519 standard.**

The TMdrive-P10e3 converter introduces a new modulation strategy IccPWM that improves harmonic performance when compared to standard PWM control. The Intelligent Current Control generates a PWM signal utilizing the current deviation vector derived from current feedback and current reference. When combined with a simple harmonic filter, compliance with IEEE-519 harmonic limits is achieved with the Intelligent Current Control.

## Functional Safety

Equipped with safety functions that comply with the functional safety standard IEC / EN 61800-5-2 [2].
As an option, STO, SS1, SLS, SBC, and SSM safety functions can be realized with SIL 3 and PL e.

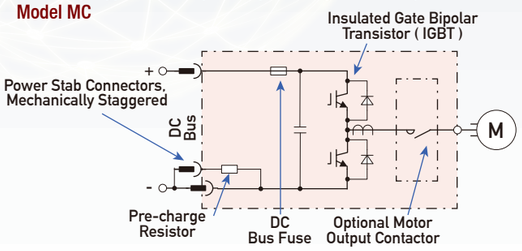
| | Safety function | | performance level | Remarks |
|---|---|---|---|---|
| standard | STO | Safe Torque Off | SIL2, PL d | |
| option | STO | Safe Torque Off | SIL 3, PL e | Requires functional safety board |
| | SS1 | Safe Stop 1 | | |
| | SLS | Safely-Limited Speed | | |
| | SBC | Safe Brake Control | | |
| | SSM | Safe Speed Monitor | | |

NOTE 2) Certification is scheduled after 2024

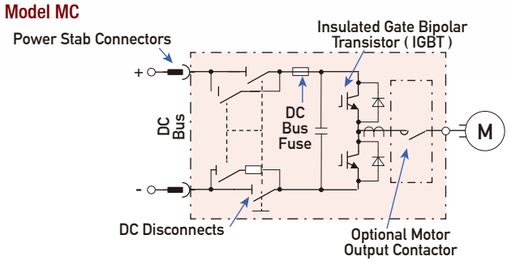
## TMdrive-10e3 Inverter Specification

### Main Circuit Configuration

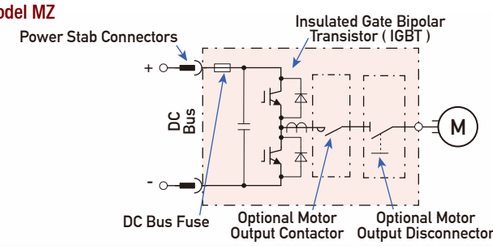
**Multistage type / with capacitor pre-charge function ( Frame 15 ~ 125 )**
**Model MC**



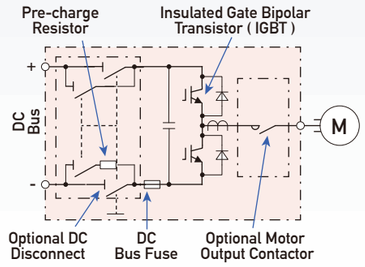

**Multistage type / with capacitor pre-charge function ( Frame 250 )**
**Model MC**



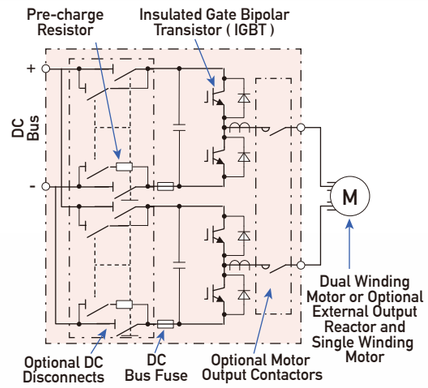

**Multistage type / without capacitor pre-charge function ( Frame 15 ~ 250 )**
**Model MZ**




**Self-standing cabinet type, single ( Frame 400 ~ 900 )**
**Model S1, S2**




**Self-standing cabinet type, twin ( Frame 1200 ~ 1800 )**
**Model S2**



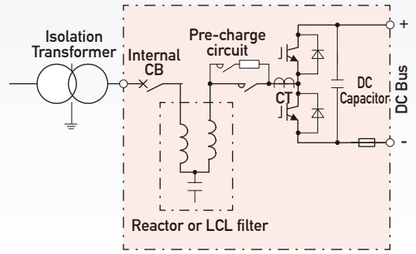

| Item | Vector control ( with speed feedback ) | Sensor-less vector control | Remarks |
|---|---|---|---|
| Inverter input voltage | 560 ~ 680 Vdc | | 440 / 460 Vac models |
| Inverter output voltage | 0 – 0.71 x input voltage | | |
| Maximum rotation speed | 6000 $min^{-1}$ for 4 pole motors, 12000 $min^{-1}$ for 2 pole motors | | |
| output frequency range | 0 ~ 200 Hz | 1.8 Hz ~ 200 Hz | |
| Speed control range | 0 ~ 100 % | 3 % ~ 100 % | |
| Speed control accuracy | ±0.01 % | ±0.1 % | For sensor-less vector control, with motor temperature sensor, one driven motor |
| | | ±1.0 % | For sensor-less vector control, with motor temperature sensor, multiple driven motors |
| Speed control response | 60 rad/s | 20 rad/s | At uncoupled test |
| Torque control range | 0 ~ 100 % | | For vector control with speed feedback, static torque applicable, a torque limit in the extremely low speed range |
| Torque control accuracy | ±3 % | Torque control not applicable | For vector control with speed feedback, when R2 is compensated by the motor temperature sensor 1) |
| | ±10 % | | For vector control with speed feedback, without the motor temperature sensor 1) |
| Maximum torque control response | 1000 rad/s | | For vector control with speed feedback |
| Maximum field weakening range | 1 : 5 | 1 : 1.5 | |
| Current control method | 2-level triangular wave PWM | | |
| PWM carrier frequency | 1.5 kHz | | |
| Speed sensor | PLG | – | Power supply voltage : 5 to 15 Vdc<br>Maximum frequency : Differential : 200 kHz, Single end : 10 kHz |
| | Resolver | – | 1 X or 4 X |
| Driven motor | Squirrel cage induction motor | | |

NOTE 1) Torque control accuracy and response are when using conventional vector control.

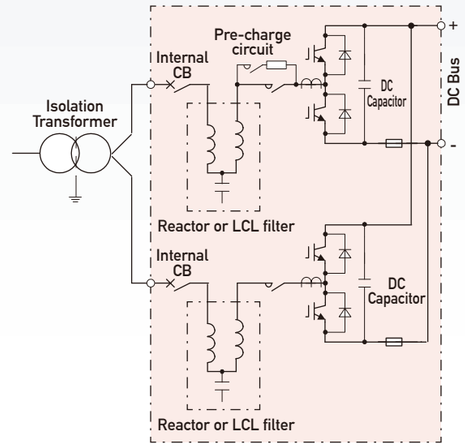
## TMdrive-P10e3 PWM Converter Specification

### Configuration of main circuit

**Single configuration**




**Twin configuration**

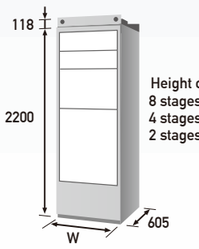
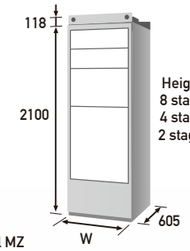
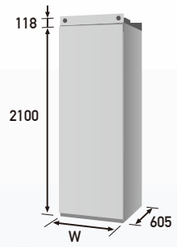
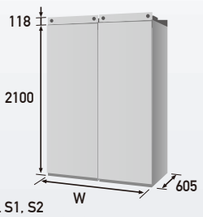



| Item | Standard specifications | |
|---|---|---|
| | Input voltage | Output voltage |
| Voltage | 380 - 400 Vac | 600 Vdc |
| | 440 - 460 Vac | 680 Vdc |
| Allowable power supply voltage variation | ±10 % | |

## TMdrive-10e3, -P10e3 Common Specifications

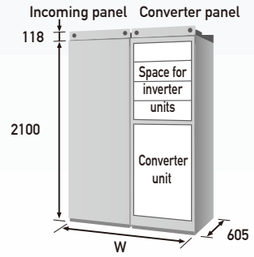
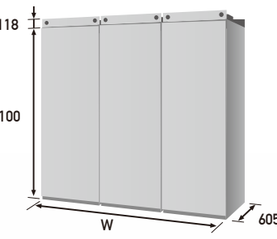
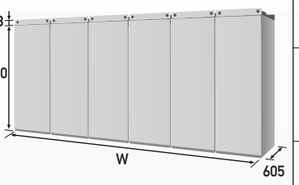
| Item | Specifications | | | |
|---|---|---|---|---|
| Compliant and conforming standard | JIS, JEC, JEM, IEC, cULus, EC directives ( CE marking ) | | | |
| Installation location | Indoor | | | |
| Ambient temperature | 0°C ~ 40°C | | | |
| Relative humidity | 5 % to 85 % or less ( no condensation ) | | | |
| Control power | 200 / 220 Vac-50 Hz or 220 / 230 Vac-60 Hz, voltage deviation : within ±10 % | | | |
| Paint color | Munsell 5Y7 / 1 ( leather tone semi-gloss ) | | | |
| Panel protection structure | Standard : IP 20, option : IP 32 | | | |
| Control network communication | TC-net I/O Loop ( electrical ) | TC-net IO Loop ( optical ) | TOSLINE-S20 | MELPLAC |
| | PROFIBUS-DP | PROFINET | CC-LINK | CC-LINK IE Field |
| | EtherCAT® | EtherNet / IP™ | DeviceNet™ | ControlNet ® |
| | Modbus TCP | Modbus RTU | | |
| Surveillance / data collection network | Ethernet 100Base, UDP | | | |
| Input | DI | UVS : 1 ch ( 24 Vdc ) | AI | ±10 Vdc or 4-20 mA : 1 ch |
| | | Programable DI : 4 ch ( 24 Vdc ) | | |
| | | STO1, STO2 : 2 ch ( 24 Vdc ) | | |
| Output | DO | STO1_F, STO2_F : 2 ch ( 24 Vdc ) | AO | ±10 Vdc : 1 ch |
| | | Programable DO : 3 ch ( 24 Vdc ) | | |
| | | Fault signal fixed DO : 1 ch ( 24 Vdc ) | | |
| Enhanced input and output | Yes ( option ) | | | |

## TMdrive-10e3 Inverter 440 / 460Vac Class

| | Reference outline drawing 1) | Frame | Panel | Output current [ A ] 100 % OL | 150 % OL | 175 % OL | 200 % OL | Mass [ kg ] each unit or each panel | Panel width W [ mm ] | Control power capacity [ kVA ] | Heat losses [ kW ] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Multistage type / with capacitor pre-charge function |  Model MC<br>Type-P : standard<br>Type-Q : with output contactor | 4 | 8 stages | 7.5 | 5.0 | 4.5 | 4.0 | 29 | 800 | 0.2 | 0.2 |
| | | 8 | 8 stages | 15 | 10 | 9.0 | 8.0 | 29 | | | 0.3 |
| | | 15 | 8 stages | 26 | 20 | 18 | 14 | 29 | | | 0.4 |
| | | 25 | 8 stages | 44 | 34 | 30 | 27 | 29 | | | 0.5 |
| | | 45 | 8 stages | 77 | 59 | 52 | 47 | 32 | | | 0.7 |
| | | 75 | 8 stages | 113 | 98 | 87 | 78 | 33 | | | 1.2 |
| | | 125 | 4 stages | 189 | 164 | 146 | 131 | 59 | | 0.3 | 2.0 |
| | | 250 | 2 stages | 322 | 270 | 242 | 218 | 110 | | | 3.6 |
| | | Multistage panel | | | | | | 260 | | 0.5 | - |
| Multistage type / without capacitor pre-charge function |  Model MZ<br>Type-A : standard<br>Type-B : with disconnect switch<br>Type-C/E : with output contactor<br>Type-D/F : with disconnect switch and output contactor | 4 | 8 stages | 5.6 | 4.4 | 4.2 | 4.0 | 23 | 800 | 0.2 | 0.2 |
| | | 8 | 8 stages | 11 | 8.8 | 8.5 | 8.0 | 23 | | | 0.3 |
| | | 15 | 8 stages | 20 | 18 | 17 | 16 | 23 | | | 0.3 |
| | | 30 | 8 stages | 45 | 35 | 34 | 32 | 25 | | | 0.6 |
| | | 60 | 8 stages | 95 | 75 | 68 | 60 | 28 | | | 1.0 |
| | | 100 | 8 stages | 125 | 125 | 112 | 103 | 28 | | 0.3 | 1.7 |
| | | 150 | 4 stages | 200 | 200 | 185 | 165 | 53 | | | 2.6 |
| | | 250 | 2 stages | 315 | 270 | 242 | 218 | 83 | | | 3.6 |
| | | Multistage panel | | | | | | 260 | - | 0.5 | - |
| Self-standing cabinet type, single |  Model S1, S2<br>Type-A : standard<br>Type-B : with disconnect switch<br>Type-C/E : with output contactor<br>Type-D/F : with disconnect switch and contactor | 400 | 1 cabinet | 504 | 455 | 420 | 395 | 280 ( 300 ) | 600 | 0.35 | 5.4 |
| | | 600 | | 833 | 700 | 670 | 630 | 460 ( 500 ) | 800 | 0.65 | 10.2 |
| | | 750 | | 1000 | 935 | 810 | 718 | 470 ( 510 ) | | | 10.8 |
| | | 900 | | 1000 | 1000 | 1000 | 925 | 480 ( 520 ) | | | 13.8 |
| | | 900 | 2 cabinets | 1280 | 1150 | 1050 | 925 | 790 | 1400 | | 13.8 |
| Self-standing cabinet type, twin |  Model S1, S2<br>Type-A : standard<br>Type-B : with disconnect switch<br>Type-C/E : with output contactor<br>Type-D/F : with disconnect switch and contactor | 1200 | 2 cabinets | 1666 | 1400 | 1340 | 1260 | 2×460 ( 2×500 ) | 2×800 | 1.3 | 20.4 |
| | | 1500 | | 2000 | 1870 | 1870 | 1436 | 2×470 ( 2×510 ) | | | 21.6 |
| | | 1800 | | 2000 | 2000 | 2000 | 1850 | 2×480 ( 2×520 ) | | | 27.6 |
| | | 1800 | 4 cabinets | 2560 | 2300 | 2100 | 1850 | 2×790 | 2×1400 | | 27.6 |

NOTE 1) Dimensions in the table are for Type-P and Type-A.

## TMdrive-P10e3 PWM Converter 440 / 460Vac Class

| | Reference outline drawing 2) | Frame | Panel | Output power [ kW ] | Output current [ A ] 150 % OL | 175 % OL | 200 % OL | Mass [ kg ] each unit or each panel | Panel width W [ mm ] | Control power capacity [ kVA ] | Heat losses [ kW ] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Multistage type 2) |  Type-F : standard<br>Type-W : without AC breaker nor AC filter | 150 | 2 cabinets | 130 | 170 | 155 | 140 | 990 | 1400 | 0.3 +0.5 | 2.3 |
| Self-standing cabinet type, single |  Type-F : standard<br>Type-W : without AC breaker nor AC filter | 400 | 3 cabinets | 298 | 390 | 350 | 308 | 1250 | 2000 | 0.9 | 4.3 |
| | | 750 | | 631 | 825 | 740 | 650 | 1550 | 2200 | 1.2 | 10.6 |
| | | 900 | | 765 | 1000 | 880 | 790 | 1600 | | | 12.7 |
| | | 1200 | 4 cabinets | 964 | 1260 | 1100 | 975 | 2120 | 3000 | 1.4 | 14.7 |
| Self-standing cabinet type, twin |  Type-F : standard<br>Type-W : without AC breaker nor AC filter | 1500 | 6 cabinets | 1263 | 1650 | 1480 | 1300 | 3100 | 4400 | 2.3 | 21.2 |
| | | 1800 | | 1530 | 2000 | 1760 | 1580 | 3200 | | | 25.4 |
| | | 2400 | 8 cabinets | 1928 | 2520 | 2200 | 1950 | 4240 | 6000 | 2.7 | 29.4 |

NOTE 2) Dimensions in the table are for Type-F.

**Precautions for application of TMdrive-10e3 series**

1) Secure a space of 500 mm or more above the panel ( minimum requirement of 255 mm or more for ceiling fan replacement ).
2) Secure 1,500 mm or more for front maintenance space.
3) All panels have a front maintenance structure, and no maintenance space is required on the back.
4) The cabinets must be installed on the channel base with flatness. The height of the standard channel base is 50mm. ( It is not included in the external dimensions in the rating table. )
5) Recommended replacement period for limited life parts ( usage conditions: annual average temperature around the panel of 25°C )

Fuses .....7 years
Ceiling cooling fan .....3 years
Air filters .....1 year
Electrolytic capacitor .....7 years
Control power supply units ....11 years
DC fan for units .....11 years
Battery ( on board ) .....7 years 3)

NOTE 3) When "MT-4969" appears on the display, replace the battery immediately.
Before replacing, make sure that the control power supply is turned off.
After replacement, the time on the CTR board will shift, so it is necessary to adjust the time.