YASKAWA

U1000
Free Standing Panel
Low Harmonics Regenerative Matrix Converter

yaskawa.eu

A class of its own

The U1000 is a highly efficient variable frequency drive (VFD) based on latest matrix converter technology. With full power regeneration capability, the U1000 offers great energy saving potential while sinusoidal input currents and a power factor close to one reduce stress on grid components like transformers and power lines. With an ultra-compact shape, the U1000 is the first choice for innovative, energy-efficient drive solutions with or without power regeneration.

Innovative matrix technology

The U1000 can be used for standard and regenerative applications with the unique advantage of direct AC-to-AC power conversion. This unique design offers the best choice for induction motors (IM) and permanent magnet motors (PM). The U1000 benefits include a near unity power factor, increasing energy efficiency, enabling power regeneration and offering a very small footprint compared to conventional regenerative solutions. Moreover, the matrix converter can automatically switch the operation into bypass mode when running at grid frequency to reduce drive losses and motor noise.

Energy saving 4Q operation

Thanks to matrix technology the U1000 can operate fully regenerative. The matrix converter is your best drive for applications like crane, conveyor, winder, escalator, lift or test bench, where braking energy flow needs to be considered. The AC to AC design does not require any braking resistor which takes space in the cabinet and creates additional heat during regenerative time.

Functional safety built-in

U1000 has integrated SIL3 STO safety performance. The matrix converter complies with ISO/EN13849-1 Cat.3 PLe and IEC/EN61508 SIL3 (two safety inputs and one EDM output).

Costs saving

In addition to a reduction of energy consumption, the U1000 provides cost-saving benefits by a simplified installation and smaller panel requirements. The U1000 does not need any braking resistor which wastes the regenerative energy into heat.

Clean power

The sinusoidal input current with a total harmonic distortion of less than 5 % and a displacement power factor of ~1 minimize losses in grid components like generators and transformers. This, at the same time, greatly reduces the potential of disturbance of other devices and improves the reliability of your system.

Time saving installation

As no external components like harmonic filters or AFD units are required, connecting a U1000 drive becomes a matter of minutes. 3 wires in, 3 wires out, no more. It cannot be easier to build up a low harmonic regenerative solution.

Low harmonic solution

The U1000 offers the best low harmonic solution in one unit. The matrix converter does not need any external harmonic filters to meet the IEEE 519 guideline and it offers a very compact size compared to other forms of harmonic mitigation at the same time.

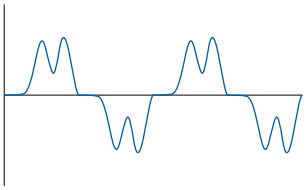
Clean grids

U1000 is the answer to power quality, energy savings, and system efficiency improvement. The advanced technology of the Yaskawa matrix drive combines all application key features in a single space-saving drive design reducing THDi to 5 % without the need for external transformers or heavy filtering.

- No oversizing of transformers, generators or cables
- Sinusoidal input current and power factor at ~ 0.98
- Compact installation - 3 wire in, 3 wire in
- Reduced lifecycle cost
- Reliable operation
- 10 years of maintenance-free design

Standard AC drive

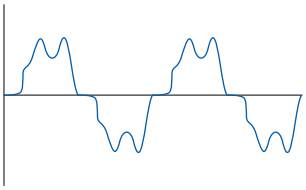
88%
Current distortion



0.75
Power factor

Standard AC drive with DC reactor

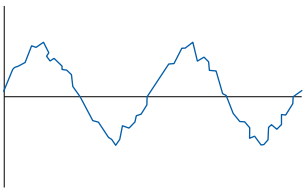
33%
Current distortion



0.9
Power factor

12 pulse system with Standard AC drive

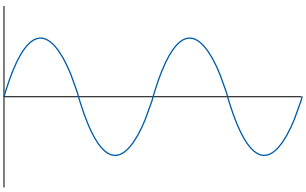
7 – 12%
Current distortion



0.95
Power factor

Matrix converter U1000

3 – 5%
Current distortion



0.98
Power factor

Consulting-Specifying Engineer
2016 Product of the Year
Most Valuable Product

Control Engineering Magazine
Engineers' Choice Awards

Minister's Prize,
The Japanese Ministry of Economy, Trade and Industry

AUTOMATICA Fair
MM Award
Innovation Prize

Uniquely designed for big scale automation

When it comes to power quality and energy savings, Yaskawa offers its greenest drive solution ever, the unique U1000 Matrix drive. Unlike conventional drives, the Yaskawa matrix technology creates a variable output waveform by switching directly from the input power – without the need for a DC bus.

High performance that pushes expectations

Building owners. Facility managers. Mechanical contractors specifying drives. They all trust Yaskawa to deliver reliable performance in any application.
Yaskawa offers:

- Industry experience
- Quick commissioning
- Easy-to-use interface
- Quick delivery
- Product quality

Yaskawa has delivered great matrix solutions (AFE drives without conventional DC bus) for industrial and commercial customers since 2014.

The U1000 family of drives pushes past industry requirements to establish a new benchmark for industry expectations.

Yaskawa Variable Frequency Drives (VFDs) deliver high quality, top-tier solutions that maximize energy efficiency performance in big scale or rough applications, saving you money.

Exceeding your expectations

More than a quarter million installed Yaskawa VFDs reliably save energy and supply fresh air and water to the buildings we use every day.

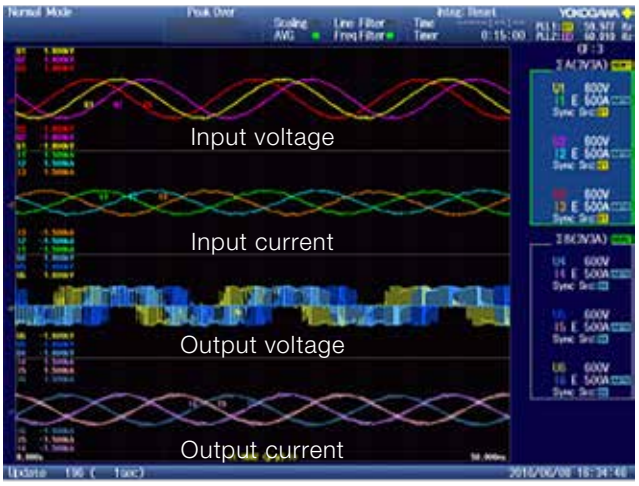
A Yaskawa representative, or partner, can help you wherever usage can deliver the biggest return on your investment.

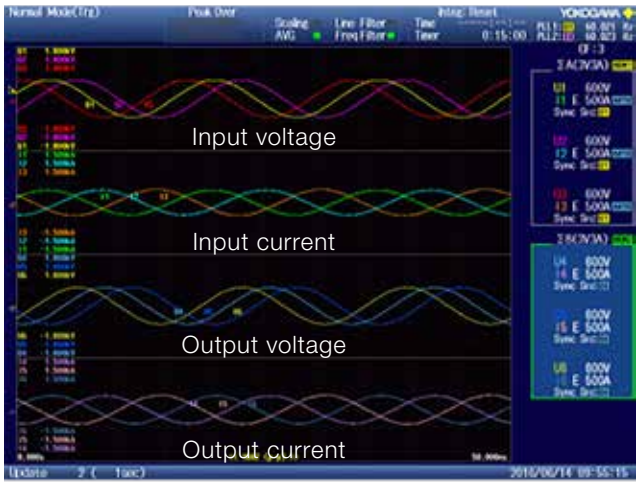
- Booster pumps
- Chiller compressors
- Chilled water pumps
- Condenser water pumps
- Condensing fans
- Cooling tower fans
- Fan arrays
- Supply and return fans

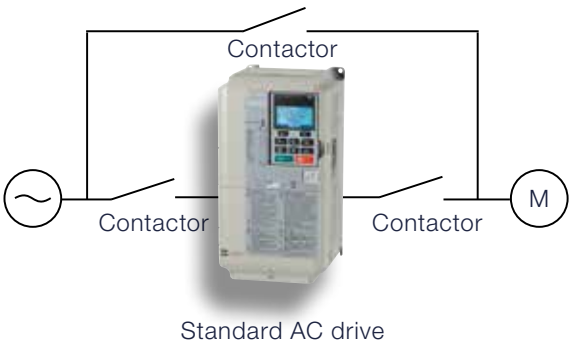
The U1000 has a built-in bypass function*. Whenever an application is matching the grid frequency, the U1000 can synchronize the motor to grid frequency. The electronic built-in bypass function eliminates switching losses. It also nearly eliminates current distortion, motor noise level and drive generated harmonics will be significantly reduced.

- No need for external bypass components (no phase detectors, contactors, peripheral devices, ...)
- Reduced AC drive losses
- Silent motor operation

* Only V/f control.







Standard AC drive

Conventional VFDs require external contactors to “bypass” the drive

U1000

Built-in automatic Bypass
(Synchronous transfer from VFD to Grid and vice versa)

Variable frequency drives reduce energy use

A typical fan or pump running at 50% speed will use one-fifth as much energy compared to systems using mechanical control methods.

The primary reason VFDs reduce energy and improve system efficiency is due to the elimination of throttling, which has been the traditional method of mechanically adjusting air or water flow in a system. VFDs control the speed of fans, pumps and compressors.

For square load applications, operators can typically achieve 20 - 70% energy savings when applying VFDs to fan and pump systems while creating a more comfortable environment. VFDs are the perfect marriage between comfort and sustainability.

- Reduced mechanical and electrical stress on fan belts, compressors and pumps
- Reduction or elimination of demand charges
- Power factor improvement
- Control and monitoring via communication protocol

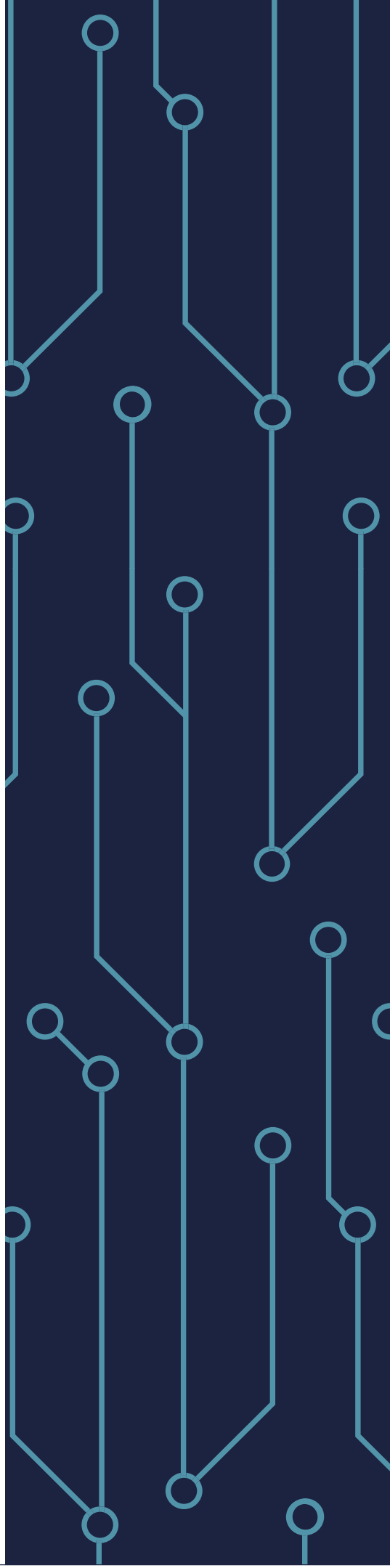
Using a VFD to reduce fan or pump speed to 50% in low demand situations will use only

1/5

the energy of full speed operation

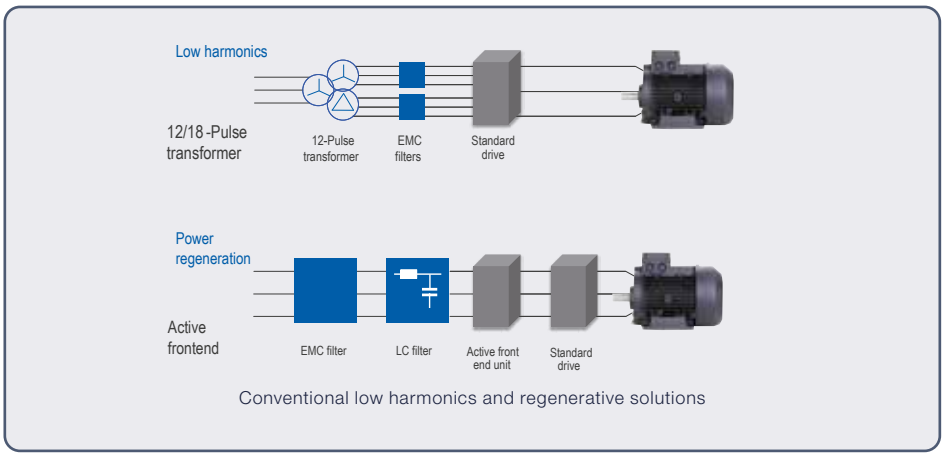
World’s best Matrix drive quality

100%



System size reduction

Conventional dynamic braking solutions with braking transistors and braking resistors need lots of space and cooling. The U1000 matrix drive is a simple 3 wire in, 3 wire out configuration. This advantage in design reduces the footprint of your application, saving about 50 % on wiring and weight while also saving 100 % of wasted energy and eliminating the risk of fire by overheating the braking resistors.



Conventional low harmonics and regenerative solutions

Super small U1000 matrix converter solution

Compact and easy

- Smaller panels
- Very compact footprint
- Simple installation in shortest time
- Perfectly fits in existing installations - easy retrofit

Designed for rough environments

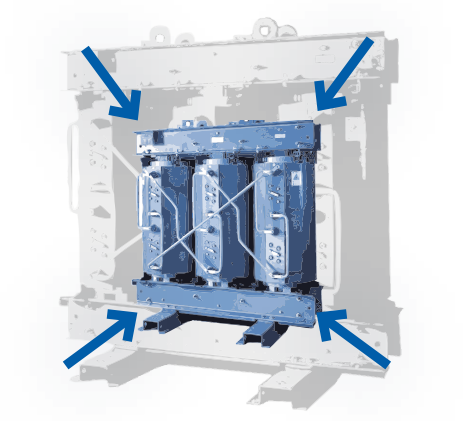
The very compact footprint combined with low harmonic performance and reduced cooling requirement allows you to run the Yaskawa Matrix drive on smaller power grids and space critical installations.

Easy modernization

System efficiency

The AC to AC design of the matrix drive creates a sinusoidal input current. It means the U1000 provides a power factor close to 1. This near unity power factor makes it possible to reduce losses in generators, transformers, and cables.

When installing the U1000 you can even design a smaller grid capacity for new installations or add more drives to existing power lines without additional stress to the power transformers.



Significantly lower your system size when modernizing

Modernization

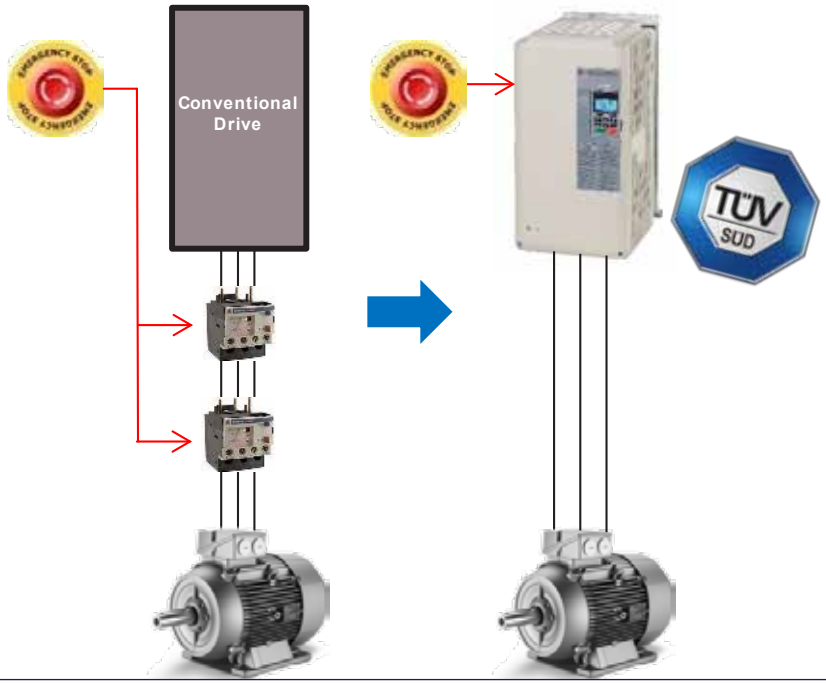
The Yaskawa matrix technology has been successfully proven in the field of low harmonic, space saving and regenerative applications. The direct AC to AC design advantage makes the setup more efficient and helps to save your operation cost sharing the regenerative energy with other electrical devices in the system.

- Low harmonic (keep IEEE 519 limits)
- No need for braking units and braking resistors or additional fusing
- Significant reduction in panel cooling requirements
- Easy conversion from an existing to a new system
- 100 % wasted energy saved
- Designed for 10 years of maintenance-free use

Built-in functional safety

U1000 comes with a built-in dual-channel safe torque off (STO) function that meets the requirements of SIL3 and PL-e, offering an easy way to improve machine safety without the need for complex external wiring.

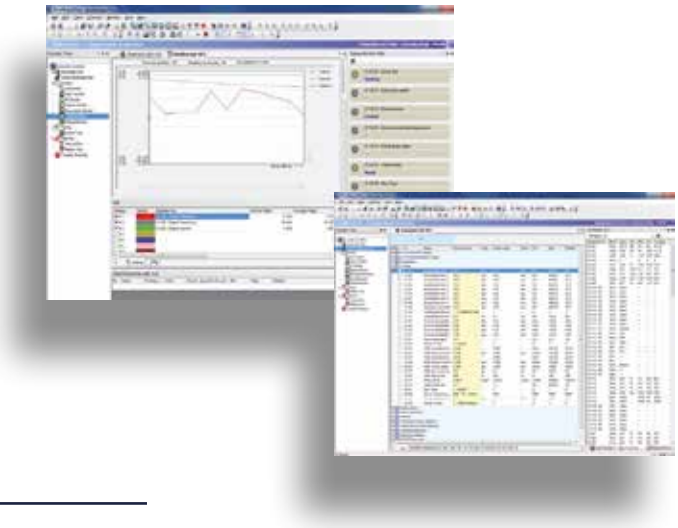
- TÜV certified according to EN/ISO 13849-1 (PL-e), IEC 62061 (SIL3)
- Simple wiring
- Less components
- Higher reliability
- Space saving



DriveWizard Plus

Manage the unique settings for all your drives right on your PC. An indispensable tool for drive setup and maintenance.

Edit application parameters, access all monitoring parameters, generate customized process flows and monitor the performance of the AC drives using the oscilloscope function.



- Convenient PC-based drive-setup, monitoring and diagnostic functions
- Built-in oscilloscope function
- Automatic parameter conversion from older series drives
- Online and offline parameter editing

DriveWorksEZ® 10

DriveWorksEZ® is an icon-based, drag-and-drop graphical environment for adding programmable functions allowing the VFD to be tailored for a variety of machine and application requirements without the cost of external controllers, such as PLCs or additional controller hardware options.

- Select from 400+ function blocks
- Logic/math functions
- Timers/counters
- Up to 100 connections
- Offline simulation mode for testing without the risk of application malfunctions
- Protection of intellectual property with project lock
- Online monitor for visual debugging
- Fast cycle time of 2 ms, independent of program size

DriveWorksEZ Application Library

The DWEZ Application Library provides pre-configured applications than can be used instantly or can be modified and expanded to fit the need of your appliciation or machine.

- These are just a few of the applications available:
- Brake sequence
- Flexible timer
- Torque limits
- Master-Slave via serial communication without PLC
- Dual PI controller
- Unbalance detection

Default configuration

Item	Specification
VFD/Drive	U1000 with internal line filter, protected by internal fast-acting fuses
Protective class	IP54
Power switch	IEC-compliant, with built-in system and cable protection, with undervoltage trigger and rotary switch (black door handle)
Ventilation	Ventilation via roof fan, outlet filter in the door
Power supply	10 A, type F socket outlet with residual current circuit breaker
Start/stop push button	In the door

Options

Item
200mm enclosure base
Control cabinet lighting
Motorized circuit breaker (instead of manual operation with a door handle)
Contactor (instead of STO contact)
70 kA or 100 kA circuit breaker

Item
Horn
Energy meter
Voltmeter and ampmeter
Lockable door handles (using a padlock or profile cylinder)

U1000 panel solution

Catalog code 400 V class

FSP4 - U1K - 930 C 20 50 0 80 1 1 A 0000

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12)

1	Drive series
FSP4	Free standing drive, 400 V

2	Drive base
U1K	U1000

3	Drive rating
...	See ratings table

4	Enclosure
A	IP21
B	IP42
C	IP54

5		Incommer option*
1st digit	0	No incommer
	A	Main disconnect (non fused) - 50 kA
	B	Main disconnect (non fused) - 75 kA
	C	Main disconnect (non fused) - 100 kA
2nd	D	Motorized main disconnect

6		Control*
1st digit	A	Keypad on door
	B	No keypad
	C	Start/Stop/Reset pushbutton
	D	Communication card (JOHB-SMP3)
2nd digit	E	Encoder card (PG-X3)
	G	Space heater
	H	Up/Down pushbutton
	I	Mains on/off pushbutton

7	Safety*
1	E-Stop pushbutton
2	Lockable door handles (using a padlock or profile cylinder)

8		Indications*
1st digit	1	Without
	2	THD/PF monitor
	3	Main power on/off
	4	3× indication lamp
2nd digit	5	Light inside panel
	6	Horn
	7	TRD (8 channel)
	8	TRD (8 channel, ProfiNet)

9	Output option*
1	Without
2	Output reactor

10	Cable entry*
1	Bottom
2	Top
4	200mm base

11	Customized drive
A	Standard
B	Customized

12	Customized version
A	0 ... 9
A	0 ... 9
A	0 ... 9
A	0 ... 9

* Options for (5) to (10) are HEX coded.
For examples, see next page.

Ratings

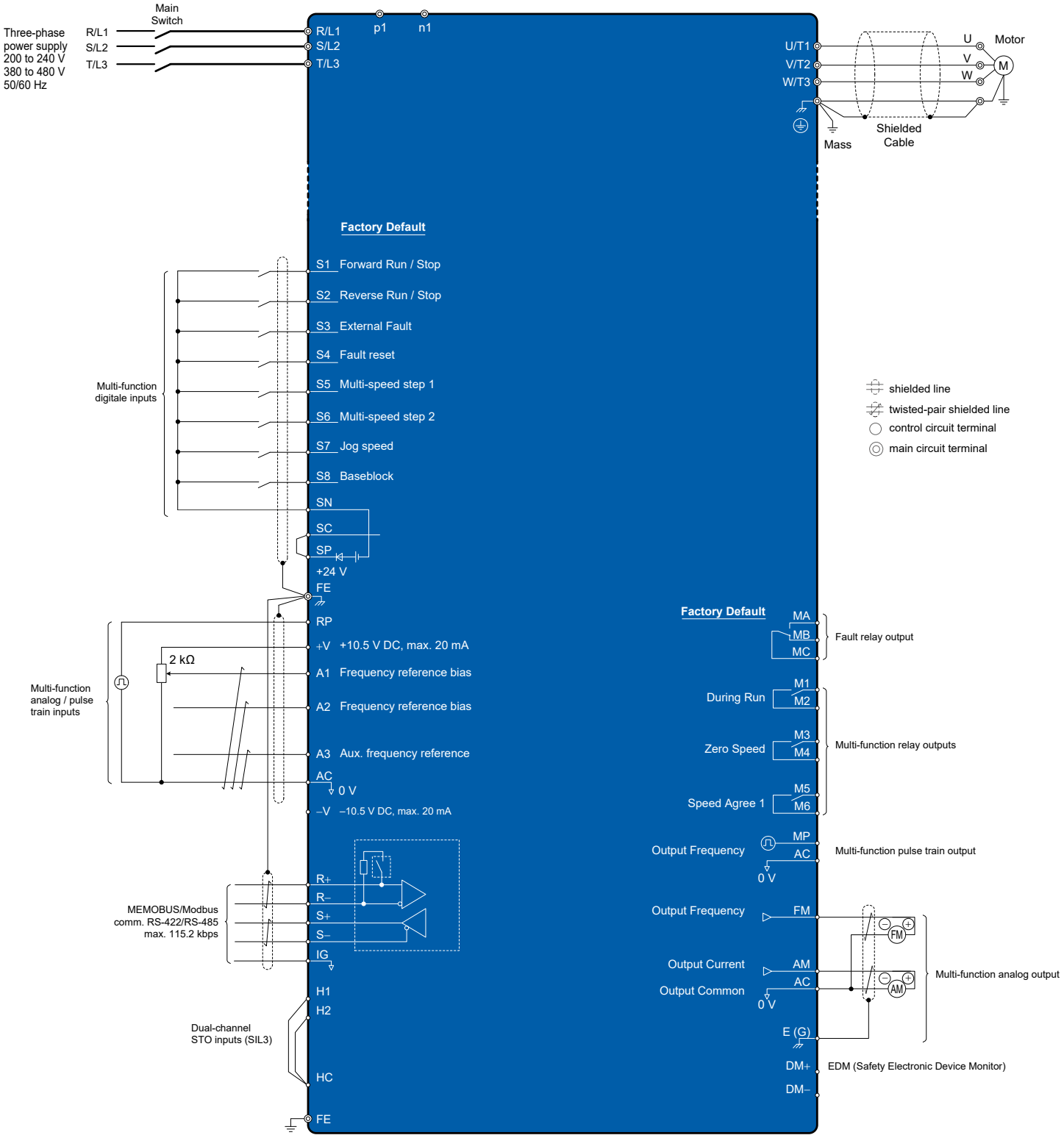
Model Code	Max appl. motor power [kW]		Rated output current [A]		Dimensions [mm]			Weight [kg]
	HD	ND	HD	ND	W	H	D	
180	75	90	156	180	1400	2230	630	680
216	90	110	180	216				680
240	110	132	216	240				680
302	132	160	240	302	1800	2430	630	825
361	160	185	302	361				850
414	185	200	361	414				850
477	200	250	414	477	2400	2500	630	1350
590	250	315	477	590				1400
720	315	355	590	720	4000	2500	630	2000
900	355	400	720	900				2000
930	400	-	900	930				2000

Option examples

5		Incommer option*	Selected Items
1st digit	0	No incommer	0
	A	Main disconnect (non fused) - 50 kA	1
	B	Main disconnect (non fused) - 75 kA	0
	C	Main disconnect (non fused) - 100 kA	0
2nd	D	Motorized main disconnect	0
		Hex. code of selected control options	**20**

6		Control*	Selected Items
1st digit	A	Keypad on door	1
	B	No keypad	0
	C	Start/Stop/Reset pushbutton	1
	D	Communication card (JOHB-SMP3)	0
2nd digit	E	Encoder card (PG-X3)	0
	G	Space heater	0
	H	Up/Down pushbutton	0
	I	Mains on/off pushbutton	0
		Hex. code of selected control options	**50**

Connection diagram*



* Typical wiring diagram. User-customizable configurations are not shown.

Specifications

Item	Specification
Input Voltage	380 to 480 VAC, +10%/-15%, 50/60 Hz +/-5%
Ambient Operating Temperature	-10 °C to +50 °C (IP54 enclosure)
Ambient Storage Temperature	-20°C to +60°C
Vibration/Shock	10 to 20 Hz: 9.8 m/s^2 (up to model 361), 5.9 m/s^2 (from model 414 and above)
	20 to 55 Hz: 2.0 m/s^2
Overload Capacity	150% for 60 seconds
Output Frequency	0.01 to 400 Hz
4Q Capability	Yes
Frequency accuracy (Temperature fluctuation)	Digital input: within ±0.01 % of the max. output frequency (-10 °C to +40 °C)
	Analog input: within ±0.1 % of the max. output frequency (25 °C ±10 °C)
Environmental	1,000 meters altitude, up to 3,000 meters with derating
	Class 3C2 and 3S2
	Max. 95 % relative humidity, non-condensing
EMC and Harmonics	EMC filter built in; complies with IEC 61800-3 restricted distribution for first environment
	5 % or less (IEEE519 compliant) under full load
Control Methods	V/f Control (V/f), V/f Control with PG (V/f w/PG), Open Loop Vector Control (OLV), Closed Loop Vector Control (CLV), Open Loop Vector Control for PM (OLV/PM), Advanced Open Loop Vector Control for PM (AOLV/PM), Closed Loop Vector Control for PM (CLV/PM)
Motor Types	Induction
	Interior Permanent Magnet (IPM)
	Surface Permanent Magnet (SPM)
Protective Design Types	IP54
Interface	LCD keypad
Directives	Low Voltage Directive (LVD): 2014/35/EU Electromagnetic Compatibility Directive (EMC): 2014/30/EU Machinery Directive (MD): 2006/42/EC Restriction of the use of certain hazardous substances (RoHS): 2011/65/EU
Applied Harmonized Standards	EN 61800-5-1:2007, EN 61800-5-1:2007/A1:2017, EN 61800-5-1:2007/A11:2021 EN 61800-3:2004, EN 61800-3:2004/A1:2012 EN IEC 62061:2021 (SIL3) EN ISO 13849-1:2015 (Cat.3, PL e) EN 61800-5-2:2007 (SIL3) EN IEC 63000:2018
Standards	EN 60204-1:2019
Standard I/O	(8) programmable multi-function digital inputs (24 VDC)
	(3) programmable multi-function analog inputs (0 to +10 VDC, 0-20 mA, 4-20 mA)
	(2) functional Safety inputs
	(1) fault relay output (Form C)
	(3) programmable multi-function relay outputs (Form A)
	(2) programmable multi-function analog output (0 to +10 VDC, 0-20 mA, 4-20 mA)
	(1) Pulse train output
Network Communications	Built in: Modbus®
	Optional: EtherCAT®, EtherNet/IP™, Profinet®, Modbus® TCP/IP, PROFIBUS DP®, DeviceNET™
Software Support Tools	DriveWizard® Plus
	DriveWorksEZ®

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