Medium-Voltage Liquid-Cooled Drives

Catalog D 15.1 · 2012
USA Edition

ROBICON Perfect Harmony

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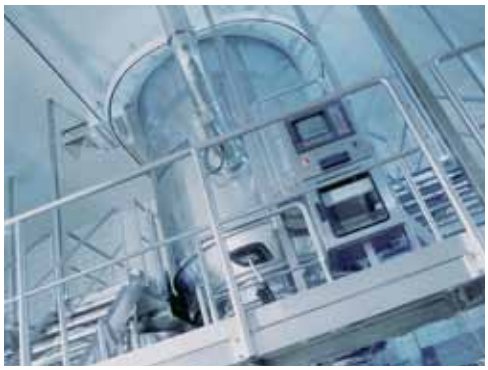
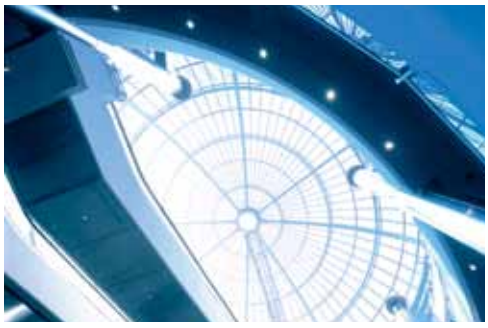
ROBICON Perfect Harmony™
Medium-voltage Liquid-Cooled Drives

Catalog D15.1 • 2012
USA Edition[1)]

1) All ROBICON Perfect Harmony medium-voltage liquid-cooled drives described in this catalog are manufactured in our New Kensington, Pennsylvania location.





Answers for industry.

Siemens Industry answers the challenges in the manufacturing and the process industry as well as in the building automation business. Our drive and automation solutions based on Totally Integrated Automation (TIA) and Totally Integrated Power (TIP) are employed in all kinds of industries. Our solutions are used in a broad range of industries from manufacturing and process automation to industrial and building applications.

Siemens offers automation, drive, and low-voltage switching technology as well as industrial software from standard products through entire industry solutions. Our industry software enables our customers to optimize the entire value chain – from product design and development through manufacture and sales up to after-sales service. Our electrical and mechanical components offer integrated technologies for the entire drive train – from couplings to gear units, from motors to control and drive solutions for all engineering industries. Our technology platform TIP offers robust solutions for power distribution.

Check out the opportunities our automation and drive solutions provide. And discover how you can sustainably enhance your competitive edge with us.

ROBICON Perfect Harmony
Liquid-cooled drives
Introduction

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Introduction

Overview

The reliable and complete range

Medium-voltage drive series	ROBICON Perfect Harmony	SINAMICS GM150 (IGBT/IGCT)	SINAMICS SM 150 (IGBT/IGCT)	SINAMICS GL150	SINAMICS SL150
Power range	150 kW to 60 MW [1]	800 kW to 17.5 MW	2.8 MW to 31.5 MW	6 MW to 120 MW	3 MW to 36 MW
Application range	General-purpose applications	General-purpose applications	Sophisticated applications	General-purpose applications	Sophisticated applications
Motors	Induction, synchronous permanent magnet [2] motors	Induction and synchronous motors	Induction and synchronous motors	Synchronous motors	Induction and synchronous motors
Energy recovery	–	—	Yes	Yes	Yes
Multi-motor drives	–	—	Yes	—	—
Semiconductor	LV-IGBT	HV-IGBT/IGCT	HV-IGBT / IGCT	Thyristor	Thyristor
Technology	Multilevel Cascaded H-Bridge topology	Neutral Point Clamed (NPC) topology	Neutral Point Clamed (NPC) topology	Load Commutated Inverter (LCI) topology	Cycloconverters
Typical applications	Pumps, fans, compressors, extruders, kneaders, mixers,crushers, agitators, conveyor systems,presses, ESP, retrofit	Pumps, fans, compressors, extruders,kneaders, mixers,crushers, agitators, conveyor systems, marine drives, presses, wire rod mills	Rolling mills, mine hoists, conveyor systems, test stands	Compressors, fans, pumps, extruders, marine drives, starting drives for blast furnaces	Rolling mills, mine hoists, excavators, ore crushers, and cement mills

The benchmark when it comes to medium-voltage drive systems

Siemens is the undisputed market leader in medium-voltage drives. Our range of products is also unique worldwide:
- Voltage classes from 2.3 to 13.8 kV
- A seamless range of power ratings from 150 kW to 60 MW
- All levels of dynamic response and performance
- Single-motor drives and multi-motor systems
- Harmonized and coordinated systems with synchronous and induction motors
- Motor speeds from 10 to 15,000 rpm in the Megawatt range

The decisive plus when it comes to experience

For decades, Siemens medium-voltage drives have offered our customers the highest degree of reliability and availability in the world.

The reliability of our drives have become legendary. Our years of experience, power of innovation and extensive knowledge has enabled Siemens to become the trusted name in the medium-voltage drive arena.

- From 1969: Variable-speed medium-voltage drive systems with current-source DC link
- From 1970: Cycloconverters – with more than 700 drives, Siemens is the global market leader
- 1994: The cell topology of ROBICON Perfect Harmony revolutionized medium-voltage drives
- 1996: "Pioneered" the use of high-rating voltage-source DC link drives in rolling applications
- 1998: "Pioneered" the use of high-voltage IGBTs for medium-voltage drives
- 2003: The highest rating high-speed drives (65 MW) with LCI for compressors of a gas liquification plant worldwide
- 2005: Highest rating drive with voltage – source DC link drives in a cell-type topology (65/45 MW) used in an LNG plant (LNG = Liquefied Natural Gas)

[1] Four drives in parallel.
[2] For more details, please contact the factory or your local Siemens sales representative.

Overview (continued)

Proven technology

Based on well-proven technological concepts, we are continually developing our medium-voltage drives. The result: increasingly higher operational reliability and safety, continually more compact types of construction, lower energy requirement and service and maintenance costs as well as increasingly simpler handling: from engineering through installation, integration and commissioning up to operator control.

Always the optimum solution

No matter which medium-voltage drive task is involved, Siemens can always offer the optimum solution. We utilize the strengths of various technologies to implement these solutions. We have the widest range of drives technologies available – from cycloconverters and load-commutated drives using thyristors through voltage-source DC link drives equipped with HV-IGBTs or IGCTs up to cell topology drives. With the latter, a medium voltage is obtained at the output by connecting low-voltage cells in series.

Benefits

According to energy authorities, industrial motors consume over a billion kilowatt hours of energy each year – 50 percent of the world's energy usage. System enhancements such as improved sizing and proper matching to load, more efficient drive trains, and adjustable speed drives will help drive energy usage down. That means that the right drive can help you drive cost out of your operation by providing more precise and efficient control of motors, fans, pumps, and other devices.

If your process includes motors, fans, or pumps and you haven't installed a drive yet, you're letting thousands of dollars of energy costs eat away at your bottom line every month because of process inefficiencies.

Siemens, the market-leader in medium-voltage air-cooled drives in the world, deliver an impressive combination of benefits:

- Lower operating costs
- Precise process control
- Lower maintenance costs
- Increased production efficiency
- Exceptional reliability
- Intuitive HMI

The ROBICON Perfect Harmony's outstanding record has made it the drive of choice for demanding applications that require the highest levels of reliability, precision, and longevity. Employed in applications ranging from power generation to oil and gas, wastewater, and paper production, the ROBICON Perfect Harmony drive is a versatile performer that can help you significantly increase productivity, enhance energy efficiency, and reduce operating costs.

Overview (continued)

The ROBICON Perfect Harmony of today represents an evolution founded on experience garnered from our huge installed base coupled with Siemens' unparalleled investments in R&D. As one of the largest companies in the world, Siemens provides confidence and financial stability in addition to exceptional technology. We offer you expertise across the globe and a world of innovation.

Application

Siemens can provide a custom-engineered ROBICON Perfect Harmony drive to maximize your process. We're the only company that offers drives from 150 to 60,000 kW. With an installed base exceeding more than 11 million kW worldwide, the ROBICON Perfect Harmony is a proven workhorse that can perform brilliantly for you, too.

A bright future built on a firm foundation

Since its introduction in 1994, the ROBICON Perfect Harmony drive has revolutionized power conversion and continues to set industry standards for reliability and innovation.

As power switching device technology advances and increases output voltage capability, Siemens improves each generation of the ROBICON Perfect Harmony in three key areas: increased reliability and availability, increased efficiency, and a smaller drive footprint.

Advances to our product line are made without "reinventing the wheel" like other drive manufacturers. We have maintained the ROBICON Perfect Harmony's core topology and continue to advance its capability, ensuring life-cycle product support. By keeping the same topology, our customers see a reduction in maintenance and spare parts as well as an increase in quality and lower life-cycle costs. We improve our products by actively soliciting the input of our customers, and look forward to counting you among them.

ROBICON Perfect Harmony Drive family overview

The ROBICON Perfect Harmony drive family consists of three core design configurations, where they are functionally identical and share a common controller. These three designs are targeted at distinct output power configurations with little overlap between the frame sizes. The ROBICON Perfect Harmony family is summarized in the 2 tables below.

Liquid-cooled product line

	WCIII
	
Power range	4000 to 19000 hp (3 MW to 14.2 MW)
Output voltage	2.3 to 8.0 kV
Input voltage	2.4 to 13.8 kVAC (standard up to 33 kV option, 50/60 Hz)
Cooling type	Liquid-cooled
Power cell ratings	880 or 1250 A at 750 V AC

Air-cooled product lines [1)]

	GenIV	GenIIIe
		
Power range	200 to 3500 hp (0.15 to 2.60 MW)	1750 to 8000 hp (1.30 to 5.96 MW)
Output voltage	2.3 to 6.6 kV	2.3 to 7.2 kV
Input voltage	2.4 to 13.8 kV AC (standard), 50/60 Hz	2.4 to 13.8 kV AC (standard), 50/60 Hz
Cooling type	Air-cooled	Air-cooled
Power cell ratings	40, 70, 100, 140, 200 or 260 A at 750 V AC	315, 375, 500 or 660 A at 690 V AC, 720 A at 630 V AC

1) Air-Cooled Perfect Harmony drives are not the subject of this catalog, please contact your local Siemens sales representative for any questions or inquiries.

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Notes

ROBICON Perfect Harmony
Liquid-cooled drives

2

Introduction

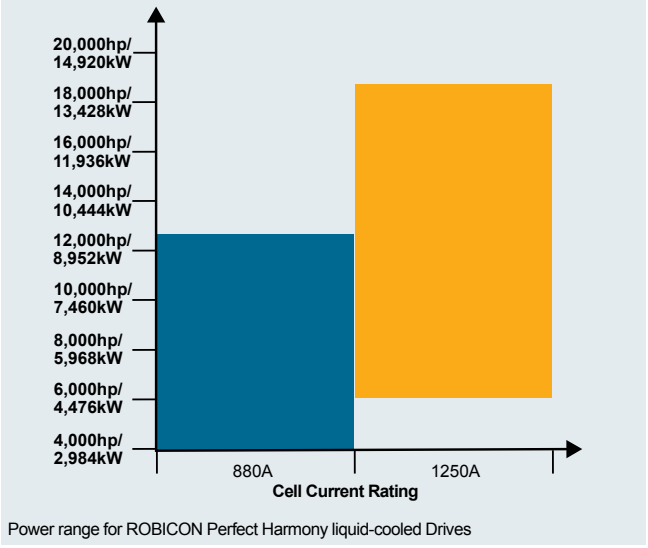
Overview

ROBICON Perfect Harmony Overview

ROBICON Perfect Harmony drives provide variable speed operation by converting utility power at fixed frequency and fixed voltage to variable frequency, variable voltage power. This conversion is done electronically without moving parts. The following table shows the main characteristics of the ROBICON Perfect Harmony liquid-cooled generation discussed in this catalog and the short terms used.

Liquid –Cooled Product Line

Product Line	Cell voltage V	Cell current A	Cooling method	Order numbers
WCIII	750	880...1250	Liquid-cooled	6SR3



Power range for ROBICON Perfect Harmony liquid-cooled Drives

Figure 2.1

Standards and regulations

ROBICON Perfect Harmony drives are designed, manufactured and tested according to applicable NEMA, ANSI, IEEE and IEC standards.

ROBICON Perfect Harmony drives meet the applicable requirements of the following EU regulations:

- Low-Voltage Directive (LVD)
  A Declaration of Conformity and attached CE mark declares conformity of the low-voltage compartments of the product (e.g. control cubicle, excitation unit etc.) with LVD 2006/95/EC and the associated standard IEC 61800-5-1 Ed.2.

- EMC Directive (EMCD)
  A factory certificate declares that the products satisfy the requirements of EMCD 2004/108/EC concerning electro-magnetic compatibility, when put to their intended use and conform to the associated standards IEC 61800-3

- Machinery Directive (MD)
  The offered products are intended solely for installation as components into a machine, system or plant. They are designed to satisfy the relevant requirements of the standards IEC 61800-5-1, IEC 60204-1 and IEC 60204-11 to allow the machine manufacturer or system / plant integrator – by appropriate usage of the products – to meet the requirements of the Machinery Directive.

  Within the European Economic Area (EEA), operation is prohibited until the conformity of the end product with Machinery Directive 2006/42/EEC has been established. It is the sole responsibility of the machine manufacturer or system / plant integrator to ensure this.

Benefits

Clean power input

The ROBICON Perfect Harmony drive:

- Meets the most stringent IEEE 519-1992 requirements for voltage and current harmonic distortion, even if the source capacity is no larger than the drive rating[1)]
- In most cases eliminates the need for costly and inefficient harmonic filters and its associated resonance problems
- Protects other online equipment from harmonic disturbance (computers, telephones and other power converters)

Power quality output

The ROBICON Perfect Harmony drive:

- Reduces common mode voltage on the motor stator windings
- Minimizes drive induced torque pulsations and associated torsional analysis compared to other medium voltage topologies, by using a motor friendly pulse width modulation (PWM) output
- Offers sinusoidal output that eliminates additional losses due to harmonics thus it can be used with new or existing motors without derating

Maximized availability

The ROBICON Perfect Harmony drive:

- Remains operational in the event of a cell failure by using the cell bypass option which bypasses the faulted cell
- Offers a Process Tolerant Protection Strategy (ProToPS) based on a hierarchical warning system that allows the operator to evaluate the drive disturbance and respond appropriately to avoid system shutdown

1) IEEE 519-1992 compliance can only be guaranteed in networks without prior disturbances or harmonics already present.

Benefits (continued)

Extended reliability

The ROBICON Perfect Harmony drive provides an integrated transformer which offers the following additional advantages:

- Simple and robust way to cancel input current harmonics without the need for input harmonic filters or a complex active frontend
- Protects power converter semiconductors against line transients
- Improves ride-through capabilities
- Completely protects the motor in case of a ground fault in the converter, the motor cabling or insulation
- Negligible common mode voltage allows the use of a standard motor eliminating the need for special high-voltage insulation
- Limits the fault energy into the converter in the unlikely event of a fault
- The incoming service voltage doesn't have to match the motor voltage

Factory test offers the following advantages:

- Each transformer and converter is tested as a complete unit at full load prior to delivery
- Factory testing allows accurate efficiency measurements to ensure that drive performance meets customer specifications
- Verification of sequence of operation and protection functions

Installation and maintenance

- The ROBICON Perfect Harmony drives are easy to install and maintain [1)]
- Customer needs to provide three cables in and three cables out. There is no customer site cabling required to connect the assembled sections.
- Power cells can be pulled out easily for maintenance due to their reduced weight and front accessible connections
- Sophisticated microprocessor-based diagnostics pinpoint the location of any defects

Application

ROBICON Perfect Harmony typical applications

The ROBICON Perfect Harmony WCIII is regularly applied by the most reliability and quality conscious industries in their most demanding applications, for example:

- Industrial pumps and fans.
- Oil and gas pumps and compressors, and high speed compressors
- Induced and forced draft boiler blowers for power generation
- Multi-motor synchronous transfer applications (such as pipelines in the oil and gas industry)

1) Commissioning of the drive has to be done by Certified Siemens Field Personnnel.

Introduction

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Design

Drive topology

The ROBICON Perfect Harmony drives achieve an uncompromising performance by employing proven technology in a modular configuration, as shown in Figure 2.2. Medium-voltage levels are obtained by combining the outputs of multiple low-voltage power cells. The low-voltage power cells are simplified variations of standard 2 level PWM motor drives for low voltage service, which have been built in high volume for many years.

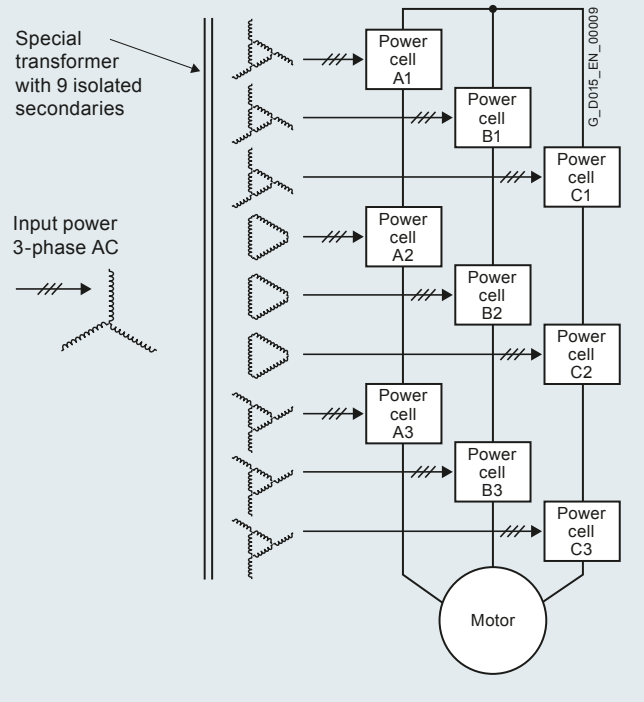


Figure 2.2 Topology of ROBICON Perfect Harmony drives (3 cells)

For higher output voltage capabilities, the ROBICON Perfect Harmony topology can be extended to have up to 8 power cells[1)] in series in each phase, with additional secondary windings (number of secondaries equals number of power cells) on the integral isolation transformer.

Each power cell is capable of receiving input power at 750 V AC, 3-phase, 50/60 Hz and delivering that power to a single phase load at a variable frequency from 0.5 to the maximum rated output frequency of the drive.

Transformer

The transformer is an integral part of the drive and cannot be specified or obtained separately. It has been carefully designed over several generations to function properly with the ROBICON Perfect Harmony drive.

ROBICON Perfect Harmony transformers are dry-type liquid-cooled. They are designed specifically for use with a particular ROBICON Perfect Harmony drive and have 9 to 18 extended delta secondaries. The secondary currents are rich in harmonics, but the primary current is virtually sinusoidal. It is very important to recognize that this is no ordinary transformer which can be obtained as an off-the-shelf item.

The usual standards, ANSI C5712.51 and C5712.91, apply to transformers with only a few windings and which are subjected to sinusoidal currents. Thus, there are some important exceptions and modifications to the application of these standards to ROBICON Perfect Harmony transformers.

Proven IGBTs

Insulated Gate Bipolar Transistors (IGBTs) form the backbone of the ROBICON Perfect Harmony drive. Built in high volumes and serving as a proven power device across the industrial power control industry, IGBT technology has been in existence for more than a decade. The stability and availability of IGBTs give reliable, long-term, lifecycle confidence.

Linked low-voltage cells

In the ROBICON Perfect Harmony, a series of low-voltage cells (see figure 2.3) are linked together to build the medium-voltage power output of the drive system. This patented modular configuration gives the ROBICON Perfect Harmony many advantages when it comes to maintenance, power quality and reliability. It also provides the basis for one of its most important advantages – increased availability through the advanced cell bypass option.

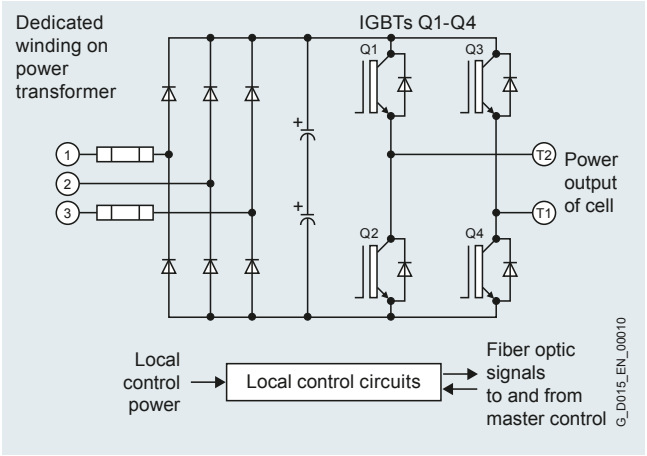


Figure 2.3 Schematic of a typical power cell.

1) WCIII is limited to 6 power cells in series.

Design (continued)

Advanced cell bypass

The ROBICON Perfect Harmony is designed to withstand failures that would overwhelm conventional drives because redundancy options are added into the system. The patented, cell-based configuration maximizes uptime and simplifies modifications.

Through a redundant bypass control that is completely separated from each power cell, the ROBICON Perfect Harmony ensures automatic bypass of a failed power cell in less than 250 ms.

Since the cells in each phase of a ROBICON Perfect Harmony drive are in series, bypassing a cell has no effect on the current capability of the drive, but the voltage capability will be reduced. Usually the required motor voltage is roughly proportional to speed, so that the maximum speed at which the drive can fulfill the application requirements will also be reduced.

Therefore, it is important to maximize the motor voltage available after one or more cells have been bypassed. The following figures illustrate the voltage available from a ROBICON Perfect Harmony drive, where the cells, represented by circles, are shown as simple voltage sources. Figure 2.4 shows a 15-cell drive in which no cells are bypassed. With 100% of the cells in use, 100% of the original voltage is available. The voltage commands to the three phase groups of cells will have phase A displaced from phase B by 120°, and from phase C by 120°.

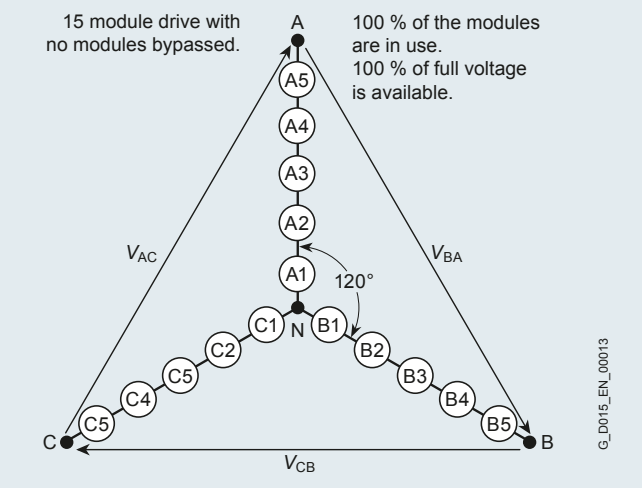


Figure 2.4 Simplified diagram of a 15 cell drive

When two cells are bypassed in phase A, the output voltage will tend to become unbalanced, as illustrated in Figure 2.5.

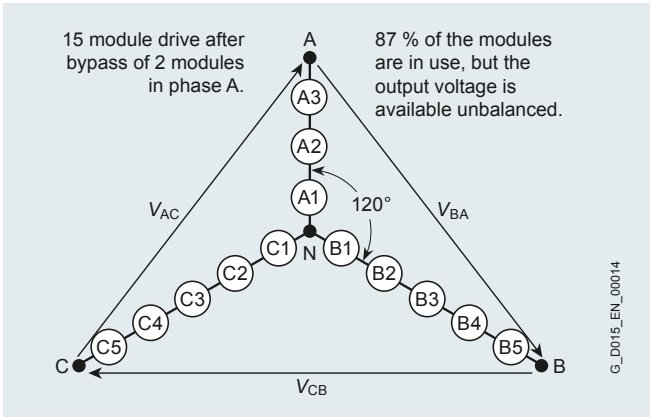


Figure 2.5 Drive output with 2 cells bypassed in phase A

One possible remedy is to bypass an equal number of cells in all three phases, even though some may not have faulted. Figure 2.6 illustrates this approach. Obviously, this method prevents unbalance but sacrifices possible voltage capability. In this figure, 87% of the cells are functional, but only 60% are in use, and only 60% of full voltage is available.

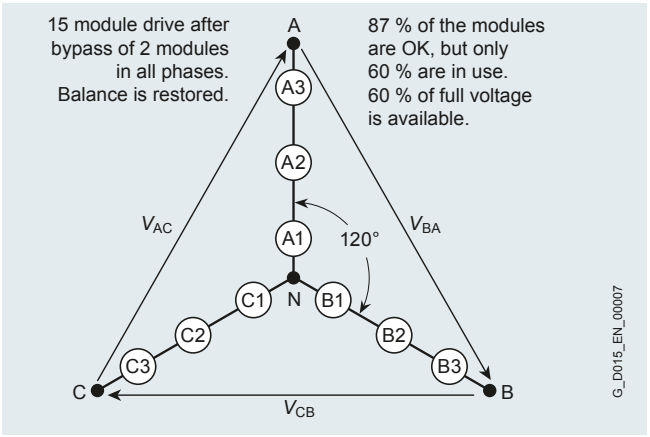


Figure 2.6 Drive output rebalanced by bypassing functional cells

A better approach is illustrated in figure 2.7. This method takes advantage of the fact that the star-point of the cells is floating, and is not connected to the neutral of the motor. Therefore the star-point can be shifted away from the motor neutral, and the phase angles of the cell voltages can be adjusted, so that a balanced set of motor voltages is obtained even though the cell group voltages are not balanced.

2

Design (continued)

Siemens calls this approach Neutral Shift.[1)] This approach is equivalent to introducing a zero-sequence component into the voltage command vectors for the cells. In the figure below, the full remaining 87% of functional cells are in use, and 80% of the original voltage is available. The phase angles of the cell voltages have been adjusted so that phase A is displaced from phase B and from phase C by 132.5°, instead of the normal 120°.

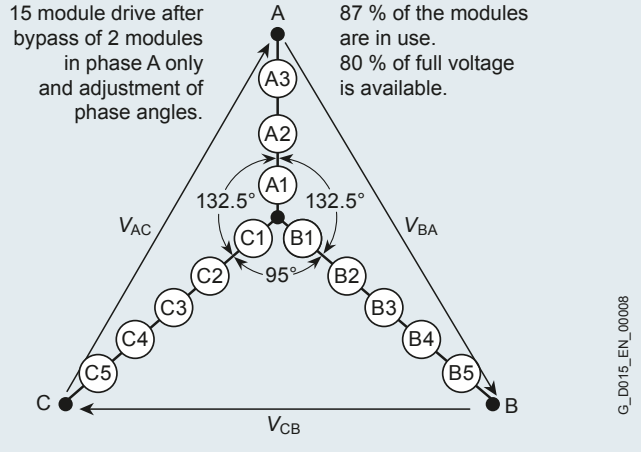


Figure 2.7 Drive output rebalanced by adjusting phase angles (Neutral Shift).

Pre-charge operation for WCIII drive

With the use of film capacitors, it has become necessary to control the inrush current into the cell modules used by the ROBICON Perfect Harmony WCIII drive. By controlling the inrush current, excessive currents and voltage overshoot within the cell are eliminated. A pre-charge system is used to control the inrush currents seen by the cells. In addition, the pre-charge circuit may be optionally used as a pre-magnetization circuit to limit transformer inrush currents.

The pre-charge circuit consists of a collection of capacitors, resistors, and contactors mounted within the Fuse/Pre-charge/Control (FPC) cabinet on the input section of the drive. (Refer to Figure 2.8). On the left is the low voltage pre-charge source coming in through the pre-charge circuit breaker into the pre-charge circuit. On the right side is the connection from the pre-charge circuit to a set of secondary windings of the input transformer. Voltage during pre-charge is monitored through the input attenuators on the primary side of the transformer. When pre-charge is complete, a contactor connects the medium voltage source to the transformer primary winding.

Note: During pre-charge, medium voltage is present on the primary side of the input transformer even though the MV Contactor is not closed.

For more Pre-Charge information please contact the factory or your local Siemens sales representative.

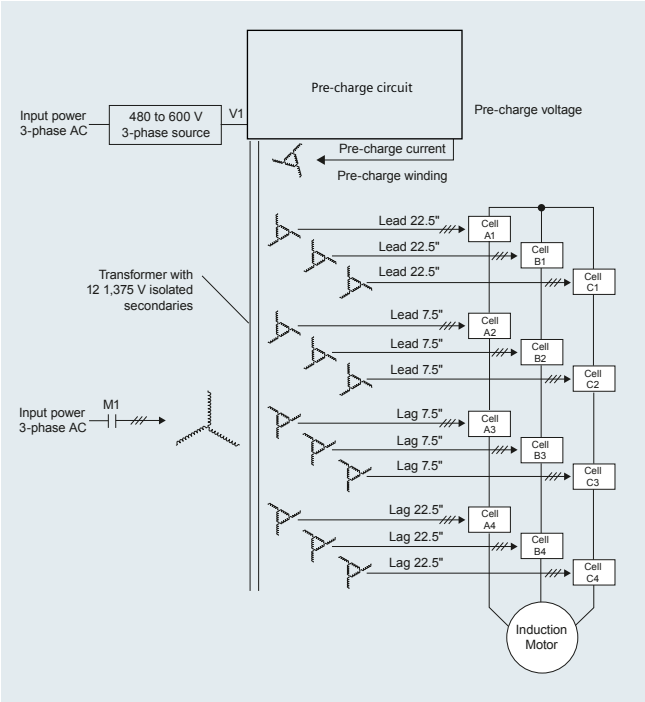


Figure 2.8 Pre-charge component connection diagram.

1) Siemens patented technology; Patent number 5,986,909.

Function

Control, protection and monitoring functions

Closed-loop control	The drive can be controlled by means of vector control algorithm without an encoder (standard) or with it (option).
Auto tuning	Auto tuning is available to optimize the control performance of the drive
Automatic restart	Automatic restart is a custom feature, used to purposely restart and restore the drive operation after a power failure or power removal. When Automatic Restart function is specified by the customer, a qualified Siemens personnel must configure and ensure the function is executes as specified
Energy saver	Energy saver control allows the reduction of motor losses, and improves overall efficiency, when the demanded motor load is low. Depending on the motor load, the control will reduce motor flux. As motor load increases, the control will increase motor flux.
Flying restart	The flying restart function permits smooth connection of the drive to a rotating motor.
Diagnostics functions	• Self-diagnosis of control hardware • Non-volatile memory for reliable diagnosis when the power supply fails • Monitoring of IGBTs with individual messages for each cell • User-friendly local operator panel with plain text messages • Fault log with first-in indication and time/date stamp
User configurable digital meters	The user can select indication of speed, voltage, current, input/output power, and efficiency on the operator panel.
Process control system	The optional Process Tolerant Protection Strategy (ProToPS) is a groundbreaking process control system available exclusively from Siemens. Instead of tripping the drive and automatically shutting down the system due to a malfunction, ProToPS provides a hierarchical system of warnings. This control strategy allows time to evaluate the situation and respond appropriately to avoid a system shutdown.
Operating hours and switching cycle counter	The amount of the time that the drive was operational since it was commissioned can be displayed. The switching cycle counter can be generated by means of an event log from the drive controller.
Detection of actual motor speed	The control algorithm calculates actual motor speed from currents and voltages measured at the drive output.
Emergency stop button	The drives are equipped as standard with an Emergency Stop button (red mushroom button with yellow collar) which is fitted in the cabinet door. The contacts of the pushbutton are connected in parallel to the terminal block so they can be integrated in a protection concept on the plant side.
Insulation monitoring	An optional output signal can be provided to operate the customer protection.
I/O monitoring	I/O signals allow user customization of the system and they can be monitored remotely or by using the operator panel display.
Thermal overload protection	Based on the output signals of the drive, the thermal motor model is calculated. The motor thermal overload protection algorithm prevents the motor from being exposed to excessive temperatures.
I/O monitoring	I/O signals allow user customization of the system and they can be monitored remotely or by using the operator panel display.
Thermal overload protection	Based on the output signals of the drive, the thermal motor model is calculated. The motor thermal overload protection algorithm prevents the motor from being exposed to excessive temperatures.

Selection and Ordering Data

Technical characteristics

WCIII

ROBICON Perfect Harmony WCIII

ROBICON Perfect Harmony WCIII is the third generation of liquid-cooled medium-voltage pulse width modulated variable frequency motor drives, offered in the patented ROBICON Perfect Harmony power topology in concert with proprietary NXGII hardware control platform and embedded software.

The WCIII is a series of adjustable speed AC motor drives presently available in an output voltage range from 2.3 kV to 8.0 kV,[1] and loads ranging from 4000 to 19000 hp. Two power cell amperage types are available: 880 and 1250 A at 750 V AC.

ROBICON Perfect Harmony WCIII, characteristics

Power semiconductors		IGBTs, diodes
Lineside rectifier		18 to 36 pulse diode rectifier
Motorside inverter		Multilevel drive (PWM) with IGBT power modules
Power cells	A	880, 1250 at 750 V
Input voltage range	kV	2.3 to 13.8
Input voltage tolerance		+10%, -5% of nominal rated input voltage
Input frequency	Hz	50/60 ± 5 %
Input power factor		≥ 0.95 above 10 % load
Input harmonics		≤ 5 % Total demand distortion (TDD)
Output voltages	kV	2.3/2.4, 3.3, 4.0/4.16, 4.6/4.8, 6.0, 6.6, 6.9/7.2
Output frequency and drift	Hz	0.5 ... 330 ± 0.5 %
Output torque		Rated torques 2 quadrant available from 10 - 167Hz [3]
Output dV/dt	V/µs	< 1000
Power range	hp	4000 to 19000 (3 to 14.2 MW) [2]
Cooling method		Deionized water with separate heat exchanger
Control		Vector Control (NGXII serious)
Motor control		• Induction motor control • Synchronous motor control • Permanent magnet motors • Wound rotor motors

WCIII cell overload capability

Required overload (I/I_N)	**Available continuous output current per cell A**	
No overload	880	1250
110 % (for 1 min, cycle time 10 min)	880	1250
150 % (for 1 min, cycle time 10 min)	660	950

Note: The WCIII drives, as standard, provide a 110% overload capability for all cell ratings without any derating.

1) 8kV output voltage is available on request, please consult the factory.
2) Drive power is limited to 15.6MVA.
3) ROBICON Perfect Harmony Drives, when derated properly, are available for high frequency applications with derated torque.

Drive Selection Criteria

The following tables help you to select the right converter type and give an overview of the corresponding motor data and order numbers. The tables are organized according to the motor voltages. For the complete technical data of the listed converter types refer to Chapter 3.

In order to select the right ROBICON Perfect Harmony drive, please take into consideration the following steps:

Step 1 – Choosing the right cell size

1.1 Determine the maximum continuous motor current, temporary overload not included:
- Use the motor full load line current (FLA) if available or use the following formula to calculate motor current *I*.

$$I_{motor} = \frac{P_{motor\_kW}}{\sqrt{3} \times V_{motor} \times PF_{motor} \times \eta_{motor}}$$

where,
P_{motor_kW} = shaft output (in kW)
V_{motor} = motor voltage
PF_{motor} = motor power factor = (cos ϕ motor)
η_{motor} = motor efficiency

(keeping in mind: motor service factor if utilized and/or overload requirements)

- If the motor power factor (*PFmotor*) and efficiency at full load are not known then use the following default values:

– PF_{motor} = 0.88
– η_{motor} = 0.96

- Factor in the motor service factor (SF) if the application will make use of it under long term operation. You do so by multiplying the given/calculated current (from step 1.1) by the motor SF.

1.2 Determine the minimum continuous cell current rating:
- If the drive is intended to operate within nominal parameters, the maximum continuous motor current will be the minimum continuous cell current rating.

1.3 Factor in any overload requirements:
- For the cell chosen on the previous paragraph, make sure it can handle the application overload requirements by checking overload capabilities (see page 2/8).
- If the overload requirements exceed the capabilities of the chosen cell then the next larger cell size must be selected.

Step 2 – Choosing the right transformer

2.1 The ROBICON Perfect Harmony transformer rating is based on the motor shaft horsepower:
- If the drive is intended to operate within nominal parameters and without added redundant cells, the maximum continuous motor horsepower (hp) will be used to rate the transformer using a straight formula: **1 transformer kVA per each motor hp**
- The above rule is followed regardless of motor type.

2.2 The transformer is designed to support the temporary overloads associated with the cells it feeds. If those levels are exceeded by the application requirements, please contact the factory or your local Siemens sales representative.

Note:

Please contact the factory or your local Siemens sales representative for derating calculations, if the drive is intended to operate outside the nominal conditions such as:
- High ambient temperatures
- High altitude installations
- Very low continuous operating frequencies at high current
- High frequency operation for high speed motors

2

Selection and ordering data

Motor voltage 3.3 kV

Motor voltage	Type rating	Shaft output 1)	Shaft output 1)	Typical motor current 1)	Power cell current	Number of cells	Transformer rating	Order number	Generation
kV	kVA	hp	kW	A	A		kVA		
3.3	3510	4000	2984	614.79	880	9	4000	6SR3252-0■B44-0■■0	WCIII
3.3	3950	4500	3357	691.64	880	9	4500	6SR3252-0■B44-5■■0	WCIII
3.3	4390	5000	3730	768.49	880	9	5000	6SR3252-0■B45-0■■0	WCIII
3.3	4830	5500	4103	845.34	880	9	5500	6SR3252-0■B45-5■■0	WCIII
3.3	5025	5726	4271	880.00	880	9	6000	6SR3252-0■B46-0■■0	WCIII
3.3	5270	6000	4476	922.19	1250	9	6000	6SR3252-0■C46-0■■0	WCIII
3.3	5710	6500	4849	999.03	1250	9	6500	6SR3252-0■C46-5■■0	WCIII
3.3	6150	7000	5222	1075.88	1250	9	7000	6SR3252-0■C47-0■■0	WCIII
3.3	6590	7500	5595	1152.73	1250	9	7500	6SR3252-0■C47-5■■0	WCIII
3.3	7030	8000	5968	1229.58	1250	9	8000	6SR3252-0■C48-0■■0	WCIII
3.3	7140	8133	6067	1250.00	1250	9	8500	6SR3252-0■C48-5■■0	WCIII

For Order Number Supplements, see pages **2-15 to 2-18**

1) The specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for typical power factor co-efficiency. Both approximate values have to be adapted to the motor that is actually used.

Selection and ordering data (continued)

Motor voltage 4.0/4.16 kV

Motor voltage	Type rating	Shaft output 1)	Shaft output 1)	Typical motor current 1)	Power cell current	Number of cells	Transformer rating	Order number	Generation
kV	kVA	hp	kW	A	A		kVA		
4.0/4.16	3950	4500	3357	570.60	880	9	4500	6SR3252-0■B44-5■■0	WCIII
4.0/4.16	4390	5000	3730	634.00	880	9	5000	6SR3252-0■B45-0■■0	WCIII
4.0/4.16	4830	5500	4103	697.40	880	9	5500	6SR3252-0■B45-5■■0	WCIII
4.0/4.16	5270	6000	4476	760.80	880	9	6000	6SR3252-0■B46-0■■0	WCIII
4.0/4.16	5710	6500	4849	824.20	880	9	6500	6SR3252-0■B46-5■■0	WCIII
4.0/4.16	6095	6940	5177	880.00	880	9	7000	6SR3252-0■B47-0■■0	WCIII
4.0/4.16	6150	7000	5222	887.60	1250	9	7000	6SR3252-0■C47-0■■0	WCIII
4.0/4.16	6590	7500	5595	951.00	1250	9	7500	6SR3252-0■C47-5■■0	WCIII
4.0/4.16	7030	8000	5968	1014.40	1250	9	8000	6SR3252-0■C48-0■■0	WCIII
4.0/4.16	7470	8500	6341	1077.80	1250	9	8500	6SR3252-0■C48-5■■0	WCIII
4.0/4.16	7910	9000	6714	1141.20	1250	9	9000	6SR3252-0■C48-7■■0	WCIII
4.0/4.16	8350	9500	7087	1204.60	1250	9	9500	6SR3252-0■C48-8■■0	WCIII
4.0/4.16	8660	9858	7354	1250.00	1250	9	10000	6SR3252-0■C52-0■■0	WCIII

For Order Number Supplements, see pages **2-15 to 2-18**

1) The specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for typical power factor co-efficiency. Both approximate values have to be adapted to the motor that is actually used.

Selection and ordering data (continued)

Motor voltage 4.6/4.8 kV

Motor voltage	Type rating	Shaft output 1)	Shaft output 1)	Typical motor current 1)	Power cell current	Number of cells	Transformer rating	Order number	Generation
kV	kVA	hp	kW	A	A		kVA		
4.8	3950	4500	3357	475.50	880	12	4500	6SR3252-1■B44-5■■0	WCIII
4.8	4390	5000	3730	528.34	880	12	5000	6SR3252-1■B45-0■■0	WCIII
4.8	4830	5500	4103	581.17	880	12	5500	6SR3252-1■B45-5■■0	WCIII
4.8	5270	6000	4476	634.00	880	12	6000	6SR3252-1■B46-0■■0	WCIII
4.8	5710	6500	4849	686.84	880	12	6500	6SR3252-1■B46-5■■0	WCIII
4.8	6150	7000	5222	739.67	880	12	7000	6SR3252-1■B47-0■■0	WCIII
4.8	6590	7500	5595	792.50	880	12	7500	6SR3252-1■B47-5■■0	WCIII
4.8	7030	8000	5968	845.34	880	12	8000	6SR3252-1■B48-0■■0	WCIII
4.8	7315	8328	6213	880.00	880	12	8500	6SR3252-1■B48-5■■0	WCIII
4.8	7470	8500	6341	898.17	1250	12	8500	6SR3252-1■C48-5■■0	WCIII
4.8	7910	9000	6714	951.00	1250	12	9000	6SR3252-1■C48-7■■0	WCIII
4.8	8350	9500	7087	1003.84	1250	12	9500	6SR3252-1■C48-8■■0	WCIII
4.8	8780	10000	7460	1056.67	1250	12	10000	6SR3252-1■C52-0■■0	WCIII
4.8	9660	11000	8206	1162.34	1250	12	11000	6SR3252-1■C52-2■■0	WCIII
4.8	10390	11830	8825	1250.00	1250	12	12000	6SR3252-1■C52-4■■0	WCIII

For Order Number Supplements, see pages **2-15 to 2-18**

1) The specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for typical power factor co-efficiency. Both approximate values have to be adapted to the motor that is actually used.

Selection and ordering data (continued)

Motor voltage 6.0 kV

Motor voltage	Type rating	Shaft output 1)	Shaft output 1)	Typical motor current 1)	Power cell current	Number of cells	Transformer rating	Order number	Generation
kV	kVA	hp	kW	A	A		kVA		
6.0	6150	7000	5222	591.74	880	15	7000	6SR3252-2■B47-0■■0	WCIII
6.0	6590	7500	5595	634.00	880	15	7500	6SR3252-2■B47-5■■0	WCIII
6.0	7030	8000	5968	676.27	880	15	8000	6SR3252-2■B48-0■■0	WCIII
6.0	7470	8500	6341	718.54	880	15	8500	6SR3252-2■B48-5■■0	WCIII
6.0	7910	9000	6714	760.80	880	15	9000	6SR3252-2■B48-7■■0	WCIII
6.0	8350	9500	7087	803.07	880	15	9500	6SR3252-2■B48-8■■0	WCIII
6.0	8780	10000	7460	845.34	880	15	10000	6SR3252-2■B52-0■■0	WCIII
6.0	9140	10410	7766	880.00	880	15	11000	6SR3252-2■B52-2■■0	WCIII
6.0	9660	11000	8206	929.87	1250	15	11000	6SR3252-2■C52-2■■0	WCIII
6.0	10540	12000	8952	1014.40	1250	15	12000	6SR3252-2■C52-4■■0	WCIII
6.0	11420	13000	9698	1098.94	1250	15	13000	6SR3252-2■C52-6■■0	WCIII
6.0	12300	14000	10444	1183.47	1250	15	14000	6SR3252-2■C52-8■■0	WCIII
6.0	12990	14787	11031	1250.00	1250	15	15000	6SR3252-2■C53-0■■0	WCIII

For Order Number Supplements, see pages **2-15 to 2-18**

1) The specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for typical power factor co-efficiency. Both approximate values have to be adapted to the motor that is actually used.

Selection and ordering data (continued)

Motor voltage 6.6 kV

Motor voltage	Type rating	Shaft output 1)	Shaft output 1)	Typical motor current 1)	Power cell current	Number of cells	Transformer rating	Order number	Generation
kV	kVA	hp	kW	A	A		kVA		
6.6	7030	8000	5968	614.79	880	15	8000	6SR3252-2■B48-0■■0	WCIII
6.6	7470	8500	6341	653.21	880	15	8500	6SR3252-2■B48-5■■0	WCIII
6.6	7910	9000	6714	691.64	880	15	9000	6SR3252-2■B48-7■■0	WCIII
6.6	8350	9500	7087	730.06	880	15	9500	6SR3252-2■B48-8■■0	WCIII
6.6	8780	10000	7460	768.49	880	15	10000	6SR3252-2■B52-0■■0	WCIII
6.6	9660	11000	8206	845.34	880	15	11000	6SR3252-2■B52-2■■0	WCIII
6.6	10055	11451	8542	880.00	880	15	12000	6SR3252-2■B52-4■■0	WCIII
6.6	10540	12000	8952	922.19	1250	15	12000	6SR3252-2■C52-4■■0	WCIII
6.6	11420	13000	9698	999.03	1250	15	13000	6SR3252-2■C52-6■■0	WCIII
6.6	12300	14000	10444	1075.88	1250	15	14000	6SR3252-2■C52-8■■0	WCIII
6.6	13180	15000	11190	1152.73	1250	15	15000	6SR3252-2■C53-0■■0	WCIII
6.6	14060	16000	11936	1229.58	1250	15	16000	6SR3252-2■C53-2■■0	WCIII
6.6	14285	16266	12134	1250.00	1250	15	17000	6SR3252-2■C53-4■■0	WCIII

For Order Number Supplements, see pages **2-15 to 2-18**

1) The specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for typical power factor co-efficiency. Both approximate values have to be adapted to the motor that is actually used.

Selection and ordering data (continued)

Motor voltage 6.9/7.2kV

Motor voltage	Type rating	Shaft output 1)	Shaft output 1)	Typical motor current 1)	Power cell current	Number of cells	Transformer rating	Order number	Generation
kV	kVA	hp	kW	A	A		kVA		
7.2	7030	8000	5968	563.56	880	18	8000	6SR3252-3■B48-0■■0	WCIII
7.2	7470	8500	6341	598.78	880	18	8500	6SR3252-3■B48-5■■0	WCIII
7.2	7910	9000	6714	634.00	880	18	9000	6SR3252-3■B48-7■■0	WCIII
7.2	8350	9500	7087	669.22	880	18	9500	6SR3252-3■B48-8■■0	WCIII
7.2	8780	10000	7460	704.45	880	18	10000	6SR3252-3■B52-0■■0	WCIII
7.2	9660	11000	8206	774.89	880	18	11000	6SR3252-3■B52-2■■0	WCIII
7.2	10540	12000	8952	845.34	880	18	12000	6SR3252-3■B52-4■■0	WCIII
7.2	10970	12492	9319	880.00	880	18	13000	6SR3252-3■B52-6■■0	WCIII
7.2	11420	13000	9698	915.78	1250	18	13000	6SR3252-3■C52-6■■0	WCIII
7.2	12300	14000	10444	986.23	1250	18	14000	6SR3252-3■C52-8■■0	WCIII
7.2	13180	15000	11190	1056.67	1250	18	15000	6SR3252-3■C53-0■■0	WCIII
7.2	14060	16000	11936	1127.12	1250	18	16000	6SR3252-3■C53-2■■0	WCIII
7.2	14930	17000	12682	1197.56	1250	18	17000	6SR3252-3■C53-4■■0	WCIII
7.2	15585	17744	13237	1250.00	1250	18	18000	6SR3252-3■C53-6■■0	WCIII

For Order Number Supplements, see pages **2-15 to 2-18**

1) The specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for typical power factor co-efficiency. Both approximate values have to be adapted to the motor that is actually used.

Selection and Ordering Data

Selection and ordering data (continued)

Order No. supplements

	1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
ROBICON Perfect Harmony drive	**6**	**S**	**R**	•	•	•	•	—	•	■	•	•	•	—	•	■	■	•
Generation																		
Generation 3				**3**														
Manufacturing location																		
Pittsburgh, USA					**2**													
Cooling																		
Liquid-cooled						**5**												
Lineside behavior																		
Basic Infeed (“Direct Front End”)							**2**											
Rated max. output voltage																		
4.0 kV 3 AC, 9 cells									**0**									
5.3 kV 3 AC, 12 cells									**1**									
6.6 kV 3 AC, 15 cells									**2**									
8.0 kV 3 AC, 18 cells									**3**									
Primary input voltage																		
2.4 kV 3 AC										**A**								
3.0 kV 3 AC										**B**								
3.3 kV 3 AC										**C**								
4.16 kV 3 AC										**D**								
4.8 kV 3 AC										**E**								
6.0 kV 3 AC										**F**								
6.3 kV 3 AC										**G**								
6.6 kV 3 AC										**H**								
6.9 kV 3 AC										**J**								
7.2 kV 3 AC										**K**								
8.4 kV 3 AC										**L**								
10.0 kV 3 AC										**M**								
11.0 kV 3 AC										**N**								
12.0 kV 3 AC										**P**								
12.47 kV 3 AC										**Q**								
13.2 kV 3 AC										**R**								
13.8 kV 3 AC										**S**								
Other voltage than standard (on request)										**X**								

Selection and ordering data (continued)

Order No. supplements (continued)

	1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
ROBICON Perfect Harmony drive	**6**	**S**	**R**	•	•	•	•	—	•	■	•	•	•	—	•	■	■	•
Cell rating																		
880 A											**B**							
1250 A											**C**							
Transformer rating																		
Other transformer rating than standard												**0**	**0**		**0**			
4000 k VA												**4**	**4**		**0**			
4500 k VA												**4**	**4**		**5**			
5000 k VA												**4**	**5**		**0**			
5500 k VA												**4**	**5**		**5**			
6000 k VA												**4**	**6**		**0**			
6500 k VA												**4**	**6**		**5**			
7000 k VA												**4**	**7**		**0**			
7500 k VA												**4**	**7**		**5**			
8000 k VA												**4**	**8**		**0**			
9000 k VA												**4**	**8**		**7**			
9500 k VA												**4**	**8**		**8**			
10000 k VA												**5**	**2**		**0**			
11000 k VA												**5**	**2**		**2**			
12000 k VA												**5**	**2**		**4**			
13000 k VA												**5**	**2**		**6**			
14000 k VA												**5**	**2**		**8**			
15000 k VA												**5**	**3**		**0**			
16000 k VA												**5**	**3**		**2**			
17000 k VA												**5**	**3**		**4**			
18000 k VA												**5**	**3**		**6**			
19000 k VA												**5**	**3**		**8**			
20000 k VA												**5**	**4**		**0**			

2

Selection and ordering data (continued)

Order No. supplements (continued)

	1	2	3	4	5	6	7		8	9	10	11	12		13	14	15	16
ROBICON Perfect Harmony drive	**6**	**S**	**R**	•	•	•	•	—	•	■	•	•	•	—	•	■	■	•
Transformer configuration																		
60 Hz, CU																**A**		
50 Hz, CU																**B**		
Auxiliary voltage																		
208 V 3 AC, 60 Hz																	**B**	
230 V 3 AC, 60 Hz																	**C**	
380 V 3 AC, 50/60 Hz																	**F**	
400 V 3 AC, 50/60 Hz																	**G**	
415 V 3 AC, 50/60 Hz																	**H**	
460 V 3 AC, 60 Hz																	**J**	
480 V 3 AC, 60 Hz																	**K**	
575 V 3 AC, 60 Hz																	**N**	
690 V 3 AC, 60 Hz																	**X**	
Special configuration with dissimilar voltages for precharge, control and cooling unit																		

Note: Not all configurations that the above order no. key allows can be configured. See the selection tables and configuration information for available drive configurations.

Selection and ordering data (continued)

WCIII Standard Drive

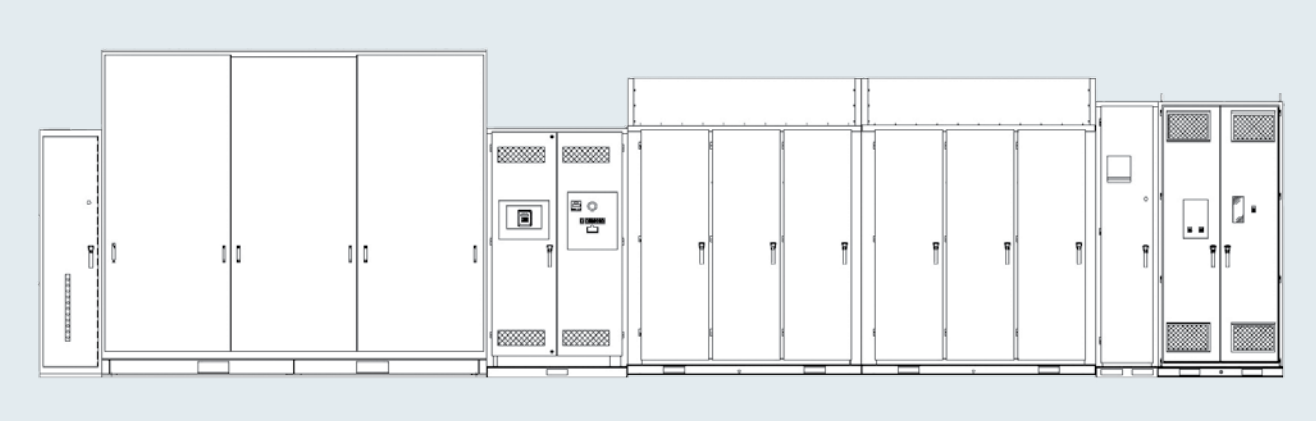


Figure 2.9 WCIII Standard Unit System

WCIII standard drive has the following configuration:

- Input cabinet
- Transformer cabinet
- FPC Cabinet (Fuse, Pre-Charge and Control)
- Cell cabinet
- Output cabinet
- Coolant cabinet

For the drive to be fully operational, customer needs to specify Heat Exchanger set up (liquid-liquid or liquid-air).[1)]

Each WCIII drive includes the following default/preset options – unless otherwise specified.[2)]

Control	Sensorless closed-loop Vector Control		Can be changed
Keypad	Located on door		Can be changed
	E-Stop		Built in
Selector Switch	Off-Local-Remote	K31	Can be changed
Supply Control Voltage	120VAC by Customer	K79	Can be changed
Transformer	Windings – Copper		Built in
	Precharge Type - Standard		Built in
Network Communication	Ethernet w/ Optic	G42	Built in
Port Connector	Ethernet	G47	Built in
Gland Plates	Gland Plates - Steel		Can be changed
Name Plates	Black Letters with White Core		Can be changed
	Language - English		Can be changed
Drive Coolant	Siemens Deionized Water	W71	Can be changed
	Siemens Propylene Glycol	W72	Can be changed
Mechanical Door Locks	Superior	M08	Can be changed

1) To define liquid-liquid or liquid-air, see section options.
2) If you choose other options, they might be mutually exclusive with default section. For more details, refer to chapter 4.

Options

Options

The tables below list the options available for the drive. Some options are mutually exclusive or may require additional information – for detailed description of options and notes, please, refer to chapter 4.

✓ Standard option

● Available option

Option Text	Order Code	WCIII
Transformer		
Synchronized pre-charge/pre-magnetization of transformer	N26	✓
Availability		
ProToPS	U10	✓
Cell bypass	U11	✓
Certifications		
Version with CE conformity	U02	✓
Version with CSA certification	U03	✓
Version with CE and GOST certification	U02 & U04	●
Design of cooling		
Drive prepared for liquid-liquid heat exchanger	W31	✓
Drive prepared for liquid-air heat exchanger	W32	✓
Design of cooling		
Converter prepared for liquid-liquid heat exhange	W31	✓
Drive prepared for liquid-air heat exhange	W32	✓
Coolant water		
Deionized water supplied by Siemens	W71	✓
Coolant glycol		
Propylene glycol supplied by Siemens	W72	✓
Protection functions		
Mechanical door interlock – Kirk	M09	✓
Mechanical door interlock – Castell	M10	✓
Mechanical door interlock – Fortress	M38	✓
Electrical door interlock	M17	✓

Option Text	Order Code	WCIII
Serial communication		
Modbus Plus interface, Network 1	G21	✓
Modbus RTU interface, Network 1	G22	✓
DeviceNet profile 12 interface, Network 1	G23	✓
Control Net interface, Network 1	G26	✓
Modbus Ethernet interface, Network 1	G28	✓
Modbus Plus interface, Network 2	G31	✓
Modbus RTU interface, Network 2	G32	✓
Modbus Ethernet interface, Network 2	G38	✓
DeviceNet profile 12 interface, Network 2	G43	✓
Control Net interface, Network 2	G46	✓
PROFIBUS DP interface, Network 1	G91	✓
PROFIBUS DP interface, Network 2	G93	✓
Port connectors		
Ethernet port connector mounted on the door	G47	✓
Functional options		
Motor static exciter furnished by customer	E00	●
Motor static exciter furnished by Siemens	E01	●
Vector control with speed encoder	K50	●
Output reactor	L09	●
Bidirectional synchronized transfer	L29	●
Keypad, Touchscreen		
Touchscreen with standard cable	A30	✓
Keypad located internal to cabinet	B85	✓
Customer specified touchscreen	Y37	●

Options

The tables below list the options available for the drive. Some options are mutually exclusive or may require additional information – for detailed description of options and notes, please, refer to chapter 4.

✓ Standard option

● Available option

Option Text	Order Code	WCIII
Control and display instruments in the door		
Sync check relay for synchronizing	**A66**	●
Keyed Off-Local-Remote selector	**K33**	✓
Customer specified equipment on right door	**Y38**	●
Keypad, Touchscreen		
Touchscreen with standard cable	**A30**	✓
Keypad located internal to cabinet	**N85**	✓
Customer specified touchscreen	**Y37**	✓
Control voltage supply		
Customer for control voltage 120 V AC by customer	**K79**	✓
I/O signal voltage 24 V DC	**K73**	✓
Control of auxiliaries		
Digital relay contactor control of external auxiliaries	**G89**	✓
Power quality monitoring (PQM)		
Multilin input power quality meter	**A67**	✓
Siemens 9510 input power quality meter	**A69**	✓
Motor monitoring		
TEC System RTD monitor	**A60**	✓
Multilin 369 motor protection relay	**A61**	✓
Multilin 369 motor protection relay with metering kit	**A62**	✓
Multilin 469 motor protection relay	**A63**	✓
Siemens 7UM61 motor protection relay	**A64**	✓
Siemens 7UM62 motor protection relay	**A65**	✓

Option Text	Order Code	WCIII
Motor voltage		
Motor voltage 2.3 kV	**V01**	✓
Motor voltage 2.4 kV	**V02**	✓
Motor voltage 3.0 kV	**V03**	✓
Motor voltage 3.3 kV	**V04**	✓
Motor voltage 4.0 kV	**V05**	✓
Motor voltage 4.16 kV	**V06**	✓
Motor voltage 4.8 kV	**V07**	✓
Motor voltage 5.0 kV	**V08**	✓
Motor voltage 5.5 kV	**V09**	✓
Motor voltage 6.0 kV	**V10**	✓
Motor voltage 6.3 kV	**V11**	✓
Motor voltage 6.6 kV	**V12**	✓
Motor voltage 6.9 kV	**V13**	✓
Motor voltage 7.2 kV	**V14**	✓

Options

Options

The tables below list the options available for the drive. Some options are mutually exclusive or may require additional information - for detailed description of options and notes, please, refer to chapter 4.

✓ Standard option

● Available option

Option Text	Order Code	WCIII
Documentation (standard: PDF format in English on CD-ROM)		
Documentation in German	**D00**	✓
Circuit diagrams, terminal diagrams and dimension drawings in DXF format (English only)	**D02**	✓
One set of printed documentation	**D15**	✓
Documentation in Czech	**D54**	●
Documentation in Polish	**D55**	●
Documentation in Russian	**D56**	✓
Documentation in Japanese	**D57**	●
Documentation in Danish	**D62**	●
Documentation in Romanian	**D71**	●
Documentation in Italian	**D72**	●
Documentation in Finnish	**D73**	●
Documentation in Dutch	**D74**	●
Documentation in Turkish	**D75**	●
Documentation in English	**D76**	✓
Documentation in French	**D77**	●
Documentation in Spanish	**D78**	●
Documentation in Portuguese (Brazil)	**D79**	✓
Documentation in Bulgarian	**D80**	●
Documentation in Norwegian	**D81**	●
Documentation in Hungarian	**D82**	●
Documentation in Swedish	**D83**	●
Documentation in Chinese	**D84**	✓
Documentation in Slovenian	**D85**	●
Documentation in Greek	**D86**	●
Documentation in Slovakian	**D87**	●
Documentation in Estonian	**D88**	●
Documentation in Latvian	**D89**	●
Documentation in Lithuanian	**D90**	●
Circuit diagrams with customer-specific description field	**Y10**	●

Option Text	Order Code	WCIII
Production schedules		
Production schedule: one issue	**B43**	✓
Production schedule: updated at 2 week intervals	**B44**	✓
Production schedule: updated once per month	**B45**	✓
Nameplate color, texture and language		
White letters with black core	**T03**	✓
Stainless steel	**T04**	✓
English/German	**T74**	●
English/Portuguese (Brazil)	**T82**	●
English/Russian	**T85**	●
English/Chinese	**T91**	●
Other options		
EMC filter	**L03**	✓
Anti-condensation heating for cabinet	**L55**	✓
Gland plate, brass	**M36**	✓
Gland plate, stainless steel	**M37**	✓
Customer specified nameplate	**Y05**	●
Cabinet external paint color other than standard	**Y09**	●

Note:
- **Redundant Cells and One Redundant Cell per Phase** options are both available for WCIII drive - these options are achieved by altering the MLFB number to reflect a greater output voltage and transformer rating. For example: a 15 cell drive with one redundant cell per phase is an 18 cell drive. Please, contact your local SIEMENS sales representative for any questions or inquiries.
- Siemens offers **extended warranty** for Robicon Perfect Harmony, please contact your local SIEMENS sales representative for any questions or inquiries
- Siemens performs rigorous **factory acceptance test** on all drives. **Additional tests** both witnessed and unwitnessed are available, please contact your local SIEMENS sales representative for any questions or inquiries.

Note: The following options are coded in the order number (refer to order No. key)
- Line connection voltage
- Transformer configuration
- Auxiliary voltage

Technical Data

Technical data

General technical data		
Power semiconductors		Diodes, IGBTs
Line-side rectifier		18 to 36 pulse diode rectifiers
Motor-side inverter		Multi-level drive (PWM) with IGBT power modules
Closed-loop control		Sensorless closed-loop control, fully digital
Drive quadrants		2
Potential separation (Power section/open- and closed-loop control)		Fiber-optic cable
Efficiency		Minimum 96.5 % including transformer, across whole power range
Regulation compliances		IEEE, ANSI, NEMA, CSA, CE
Paint finish color		ANSI 61 gray
Degree of protection		
MV enclosures		• NEMA 12(standard)/IP54(optional) [1]
LV enclosures		• NEMA 1 (standard)/IP21 (standard) [1] • NEMA 12 (optional)/IP54 (optional) [1]
Water cooling		Deionized water with separate liquid-to-air or liquid-to-liquid heat exchanger
Altitude [2]	ft	0 ... 3300 without derating
	m	0 ... 1000 without derating
Permissible ambient temperature		Refer to table below

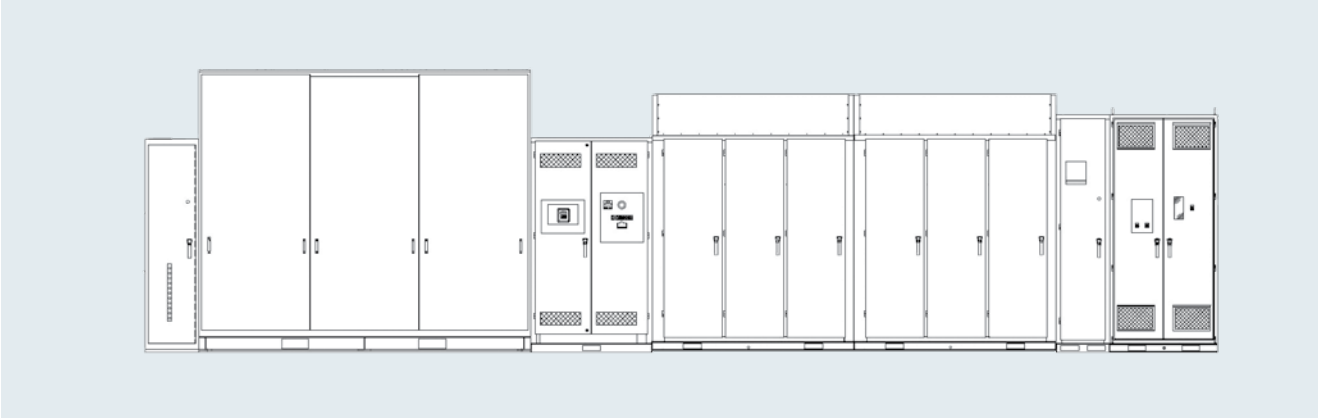
[1] According to IEC 60529.
[2] For altitudes above 3300 ft., (1000 m), please contact the factory.

Technical data

		Storage	Transport	Operation
Climatic ambient conditions				
Ambient temperature	°C	+5 to +45 (no cooling water in the system)	-25 to +60 (no cooling water in the system)	+5 to +40 [1] +5 to +50 [2]
Relative air humidity		< 95 % (only slight condensation permitted; drive must be completely dry before commissioning)	< 95 % (only slight condensation permitted; drive must be completely dry before commissioning)	< 95 % (condensation not permitted)
Other climatic conditions		1K3, 1Z2 in acc. with IEC 60721-3-1	2K2 in acc. with IEC 60721-3-2	3K3 in acc. with IEC 60721-3-3
Degree of pollution		2 without conductive pollution in acc. with IEC 61800-5	2 without conductive pollution in acc. with IEC 61800-5	2 without conductive pollution in acc. with IEC 61800-5
Mechanical ambient conditions				
Stationary vibration, sinusoidal • Displacement • Acceleration	 mm m/s [3] m/s [3]	 1.5 (2 to 9 Hz) 5 (9 to 200 Hz)	 3.5 (2 to 9 Hz) 10 (9 to 200 Hz) 15 (200 to 500 Hz)	 0.3 (2 to 9 Hz) 1 (9 to 200 Hz)
Other mechanical conditions in accordance with class		1M2 in acc. with IEC 60721-3-1	2M2 in acc. with IEC 60721-3-2 [4]	3M1 in acc. with IEC 60721-3-3
Other ambient conditions				
Biological ambient conditions		1B1 in acc. with IEC 60721-3-1	2B1 in acc. with IEC 60721-3-2	3B1 in acc. with IEC 60721-3-3
Chemical active substances in accordance with class		1C1 in acc. with IEC 60721-3-1	2C1 in acc. with IEC 60721-3-2	3C1 in acc. with IEC 60721-3-3
Mechanical active substances in accordance with class		1S1 in acc. with IEC 60721-3-1	2S1 in acc. with IEC 60721-3-2	3S1 (with optional NEMA 12/IP54 MV enclosures) in acc. with IEC 60721-3-3

1) Maximum 104°F / 40°C drive ambient air temperature with maximum 117°F / 47°C drive inlet water temperature.
2) Maximum 122°F / 50°C drive ambient air temperature with maximum 104°F / 40°C drive inlet water temperature.
3) For altitudes above 3300 ft., (1000 m), please contact the factory.
4) Siemens equipment meets all 2M2 conditions except free fall and pitch and roll.

Schematic drawing of WCIII drives



WCIII for motor voltages 3.3 to 7.2kV; schematic drawing **A**

For dimensions of WCIII drives, see the following technical data tables.

Technical data

ROBICON Perfect Harmony liquid-cooled drive version		6SR3252-0.B44-0..0	6SR3252-0.B44-5..0	6SR3252-0.B45-0..0	6SR3252-0.B45-5..0	6SR3252-0.B46-0..0
Motor voltage 3.3						
Max. output voltage	kV	4	4	4	4	4
Type rating	kVA	3510	3950	4390	4830	5025
Shaft output [1]	hp	4000	4500	5000	5500	5726
	kW	2984	3357	3730	4103	4271
Typical motor current [1]	A	614.79	691.64	768.49	845.34	880.00
Power cell current	A	880	880	880	880	880
Number of cells		9	9	9	9	9
Transformer rating	kVA	4000	4500	5000	5500	6000
Power losses of drive system						
• Copper transformer	kW	< 140	< 158	< 175	< 193	< 210
Efficiency P_{out}/P_{in} [2] **of drive system**						
• Copper transformer	%	96.5	96.5	96.5	96.5	96.5
Auxiliary supply						
• Single-phase w/o options [3]	kVA	2.5	2.5	2.5	2.5	2.5
• Single-phase w/ all options [3]	kVA	2.5	2.5	2.5	2.5	2.5
• Three-phase w/o CPT [4]	kVA	25	25	25	25	25
• Three-phase w/ CPT and all -options [4]	kVA	27.5	27.5	27.5	27.5	27.5
System pre-charge [5]	%	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cooling water requirement	–	Determined by actual design of external liquid-to-air or liquid-to-liquid heat exchanger				
Power cabling cross sections [6]						
• Cable cross-sections, line-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• Cable cross-sections, motor-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• PE [7] connection, max. connection cross-section at enclosure with ½" bolt	AWG/MCM (NEC, CEC)	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM
	mm^2 (DIN VDE)	500	500	500	500	500
Degree of protection	MV LV	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21
Drive dimensions (overall drive dimensions)						
• Width	in mm	370 9400	370 9400	370 9400	370 9400	370 9400
• Height	in mm	114 2894	114 2894	114 2894	114 2894	114 2894
• Depth	in mm	66 1680	66 1680	66 1680	66 1680	66 1680
• Dimension drawing [8]		A	A	A	A	A
Drive weight (cell cabinet and transformer cabinet)						
• Weight [9]	lb kg	33566 21837	34672 22339	35719 22814	36716 23266	37670 23699

1) The Specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical power factor ***cos*** and motor efficiency. Both approximate values have to be adapted to the motor that is actually used.
2) Values at 100% of rated speed and torque; includes drive and input transformer.
3) 120/240 V AC for NXGII control and 120 V AC internal heat exchanger in water-cooled systems.
4) Includes cooling blowers/pumps; largest unit shown. CPT: Control power transformer.
5) Percentage of transformer kVA.
6) Maximum installable size per phase.
7) PE - Protective Earth.
8) For dimension drawings please refer to Section 5, pg 5/11.
9) Drive Weight is based on cell cabinet, transformer cabinet, and coolant cabinet only.

Technical Data

Technical data (continued)

ROBICON Perfect Harmony liquid-cooled drive version		6SR3252-0.C46-0..0	6SR3252-0.C46-5..0	6SR3252-0.C47-0..0	6SR3252-0.C47-5..0	6SR3252-0.C48-0..0	6SR3252-0.C48-5..0
Motor voltage 3.3							
Max. output voltage	kV	4	4	4	4	4	4
Type rating	kVA	5270	5710	6150	6590	7030	7140
Shaft output [1]	hp kW	6000 4476	6500 4849	7000 5222	7500 5595	8000 5968	8133 6067
Typical motor current [1]	A	922.19	999.03	1075.88	1152.73	1229.58	1250.00
Power cell current	A	1250	1250	1250	1250	1250	1250
Number of cells		9	9	9	9	9	9
Transformer rating	kVA	6000	6500	7000	7500	8000	8500
Power losses of drive system							
• Copper transformer	kW	< 210	< 228	< 245	< 263	< 280	< 298
Efficiency P_{out}/P_{in} [2] **of drive system**							
• Copper transformer	%	96.5	96.5	96.5	96.5	96.5	96.5
Auxiliary supply							
• Single-phase w/o options [3]	kVA	2.5	2.5	2.5	2.5	2.5	2.5
• Single-phase w/ all options [3]	kVA	2.5	2.5	2.5	2.5	2.5	2.5
• Three-phase w/o CPT [4]	kVA	25	25	25	25	25	25
• Three-phase w/ CPT and all -options [4]	kVA	27.5	27.5	27.5	27.5	27.5	27.5
System pre-charge [5]	%	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	
Cooling water requirement	—	Determined by actual design of external liquid-to-air or liquid-to-liquid heat exchanger					
Power cabling cross sections [6]							
• Cable cross-sections, line-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• Cable cross-sections, motor-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• PE [7] connection, max. connection cross-section at enclosure with ½" bolt	AWG/MCM (NEC, CEC)	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM
	mm^2 (DIN VDE)	500	500	500	500	500	500
Degree of protection	MV LV	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/IP54 NEMA 1/IP21
Drive dimensions (overall drive dimensions)							
• Width	in mm	370 9400	370 9400	378 9600	378 9600	378 9600	378 9600
• Height	in mm	114 2894	114 2894	115 2920	115 2920	115 2920	115 2920
• Depth	in mm	66 1680	66 1680	66 1680	66 1680	66 1680	66 1680
• Dimension drawing [8]		A	A	A	A	A	A
Drive weight (cell cabinet and transformer cabinet)							
• Weight [9]	lb kg	38770 24799	39685 25214	40567 25614	41418 26000	42242 26373	43041 26736

1) The Specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical power factor ***cos*** and motor efficiency. Both approximate values have to be adapted to the motor that is actually used.
2) Values at 100% of rated speed and torque; includes drive and input transformer.
3) 120/240 V AC for NXGII control and 120 V AC internal heat exchanger in water-cooled systems.
4) Includes cooling blowers/pumps; largest unit shown. CPT: Control power transformer.
5) Percentage of transformer kVA.
6) Maximum installable size per phase.
7) PE - Protective Earth.
8) For dimension drawings please refer to Section 5, pg 5/11.
9) Drive Weight is based on cell cabinet, transformer cabinet, and coolant cabinet only.

Technical data (continued)

ROBICON Perfect Harmony liquid-cooled drive version		6SR3252-0.B44-5..0	6SR3252-0.B45-0..0	6SR3252-0.B45-5..0	6SR3252-0.B46-0..0	6SR3252-0.B46-5..0	6SR3252-0.B47-0..0
Motor voltage 4.0/4.16 kV							
Max. output voltage	kV	4	4	4	4	4	4
Type rating	kVA	3950	4390	4830	5270	5710	6095
Shaft output [1]	hp kW	4500 3357	5000 3730	5500 4103	6000 4476	6500 4849	6940 5177
Typical motor current [1]	A	570.60	634.00	697.40	760.80	824.20	880.00
Power cell current	A	880	880	880	880	880	800
Number of cells		9	9	9	9	9	9
Transformer rating	kVA	4500	5000	5500	6000	6500	7000
Power losses of drive system							
• Copper transformer	kW	< 158	< 175	< 193	< 210	< 228	< 245
Efficiency P_{out}/P_{in} [2] **of drive system**							
• Copper transformer	%	96.5	96.5	96.5	96.5	96.5	96.5
Auxiliary supply							
• Single-phase w/o options [3]	kVA	2.5	2.5	2.5	2.5	2.5	2.5
• Single-phase w/ all options [3]	kVA	2.5	2.5	2.5	2.5	2.5	2.5
• Three-phase w/o CPT [4]	kVA	25	25	25	25	25	25
• Three-phase w/ CPT and all -options [4]	kVA	27.5	27.5	27.5	27.5	27.5	27.5
System pre-charge [5]	%	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cooling water requirement	—	Determined by actual design of external liquid-to-air or liquid-to-liquid heat exchanger					
Power cabling cross sections [6]							
• Cable cross-sections, line-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• Cable cross-sections, motor-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• PE [7] connection, max. connection cross-section at enclosure with ½" bolt	AWG/MCM (NEC, CEC)	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM
	mm^2 (DIN VDE)	500	500	500	500	500	500
Degree of protection	MV LV	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/IP54 NEMA 1/IP21
Drive dimensions (overall drive dimensions)							
• Width	in mm	370 940	370 940	370 940	370 940	370 940	378 960
• Height	in mm	114 2896	114 2896	114 2896	114 2896	114 2896	115 2920
• Depth	in mm	66 1680	66 1680	66 1680	66 1680	66 1680	66 1680
• Dimension drawing [8]		A	A	A	A	A	A
Drive weight (cell cabinet and transformer cabinet)							
• Weight [9]	lb kg	35672 22792	36719 23267	37716 23719	38670 24152	39585 24567	40467 24967

1) The Specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical power factor ***cos*** and motor efficiency. Both approximate values have to be adapted to the motor that is actually used.
2) Values at 100% of rated speed and torque; includes drive and input transformer.
3) 120/240 V AC for NXGII control and 120 V AC internal heat exchanger in water-cooled systems.
4) Includes cooling blowers/pumps; largest unit shown. CPT: Control power transformer.
5) Percentage of transformer kVA.
6) Maximum installable size per phase.
7) PE - Protective Earth.
8) For dimension drawings please refer to Section 5, pg 5/11.
9) Drive Weight is based on cell cabinet, transformer cabinet, and coolant cabinet only.

Technical data (continued)

ROBICON Perfect Harmony liquid-cooled drive version		6SR3252-0.C47-0..0	6SR3252-0.C47-5..0	6SR3252-0.C48-0..0	6SR3252-0.C48-5..0	6SR3252-0.C48-7..0	6SR3252-0.C48-8..0	6SR3252-0.C52-0..0
Motor voltage 4.0/4.16 kV								
Max. output voltage	kV	4	4	4	4	4	4	4
Type rating	kVA	6150	6590	7030	7470	7910	8350	8660
Shaft output [1]	hp kW	7000 5222	7500 5595	8000 5968	8500 6341	9000 6714	9500 7087	9858 7354
Typical motor current [1]	A	887.60	951.00	1014.40	1077.80	1141.20	1204.60	1250.00
Power cell current	A	1250	1250	1250	1250	1250	1250	1250
Number of cells		9	9	9	9	9	9	9
Transformer rating	kVA	7000	7500	8000	8500	9000	9500	10000
Power losses of drive system • Copper transformer	kW	< 245	< 263	< 280	< 298	< 315	< 333	< 350
Efficiency P_{out}/P_{in} [2] **of drive system** • Copper transformer	%	96.5	96.5	96.5	96.5	96.5	96.5	96.5
Auxiliary supply								
• Single-phase w/o options [3]	kVA	2.5	2.5	2.5	2.5	2.5	2.5	2.5
• Single-phase w/ all options [3]	kVA	2.5	2.5	2.5	2.5	2.5	2.5	2.5
• Three-phase w/o CPT [4]	kVA	25	25	25	25	25	25	25
• Three-phase w/ CPT and all -options [4]	kVA	27.5	27.5	27.5	27.5	27.5	27.5	27.5
System pre-charge [5]	%	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cooling water requirement	—	Determined by actual design of external liquid-to-air or liquid-to-liquid heat exchanger						
Power cabling cross sections [6]								
• Cable cross-sections,line-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• Cable cross-sections, motor-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• PE [7] connection, max. connection cross-section at enclosure with ½" bolt	AWG/MCM (NEC, CEC)	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM
	mm^2 (DIN VDE)	500	500	500	500	500	500	
Degree of protection	MV LV	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21
Drive dimensions (overall drive dimensions)								
• Width	in mm	378 9600	378 9600	378 9600	378 9600	378 9600	378 9600	
• Height	in mm	115 2920	115 2920	115 2920	115 2920	115 2920	115 2920	
• Depth	in mm	66 1680	66 1680	66 1680	66 1680	66 1680	66 1680	
• Dimension drawing [8]		A	A	A	A	A	A	
Drive weight (cell cabinet and transformer cabinet)								
• Weight [9]	lb kg	41567 26067	42418 26453	43242 26827	44041 27189	44817 27541	45572 27884	46308 28218

1) The Specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical power factor **cos** and motor efficiency. Both approximate values have to be adapted to the motor that is actually used.
2) Values at 100% of rated speed and torque; includes drive and input transformer.
3) 120/240 V AC for NXGII control and 120 V AC internal heat exchanger in water-cooled systems.
4) Includes cooling blowers/pumps; largest unit shown. CPT: Control power transformer.
5) Percentage of transformer kVA.
6) Maximum installable size per phase.
7) PE - Protective Earth.
8) For dimension drawings please refer to Section 5, pg 5/11.
9) Drive Weight is based on cell cabinet, transformer cabinet, and coolant cabinet only.

Technical data (continued)

ROBICON Perfect Harmony liquid-cooled drive version		6SR3252-1.B44-5..0	6SR3252-1.B45-0..0	6SR3252-1.B45-5..0	6SR3252-1.B46-0..0	6SR3252-1.B46-5..0
Motor voltage 4.6/4.8 kV						
Max. output voltage	kV	5.3	5.3	5.3	5.3	5.3
Type rating	kVA	3950	4390	4830	5270	5710
Shaft output [1]	hp	4500	5000	5500	6000	6500
	kW	3357	3730	4103	4476	4849
Typical motor current [1]	A	475.50	528.34	581.17	634.00	686.84
Power cell current	A	880	880	880	880	880
Number of cells		12	12	12	12	12
Transformer rating	kVA	4500	5000	5500	6000	6500
Power losses of drive system						
• Copper transformer	kW	< 158	< 175	< 193	< 210	< 228
Efficiency P_{out}/P_{in} [2] **of drive system**						
• Copper transformer	%	96.5	96.5	96.5	96.5	96.5
Auxiliary supply						
• Single-phase w/o options [3]	kVA	2.5	2.5	2.5	2.5	2.5
• Single-phase w/ all options [3]	kVA	2.5	2.5	2.5	2.5	2.5
• Three-phase w/o CPT [4]	kVA	25	25	25	25	25
• Three-phase w/ CPT and all -options [4]	kVA	27.5	27.5	27.5	27.5	27.5
System pre-charge [5]	%	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cooling water requirement	–	Determined by actual design of external liquid-to-air or liquid-to-liquid heat exchanger				
Power cabling cross sections [6]						
• Cable cross-sections, line-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• Cable cross-sections, motor-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• PE [7] connection, max. connection cross-section at enclosure with ½" bolt	AWG/MCM (NEC, CEC)	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM
	mm^2 (DIN VDE)	500	500	500	500	500
Degree of protection	MV LV	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21
Drive dimensions (overall drive dimensions)						
• Width	in mm	398 10110	406 10310	406 10310	406 10310	406 10310
• Height	in mm	114 2894	115 2920	115 2920	115 2920	115 2920
• Depth	in mm	66 1680	66 1680	66 1680	66 1680	66 1680
•Dimension drawing [8]		A	A	A	A	A
Drive weight (cell cabinet and transformer cabinet)						
• Weight [9]	lb kg	41765 18945	42822 19424	43830 19881	44793 20318	45718 20738

1) The Specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical power factor ***cos*** and motor efficiency. Both approximate values have to be adapted to the motor that is actually used.
2) Values at 100% of rated speed and torque; includes drive and input transformer.
3) 120/240 V AC for NXGII control and 120 V AC internal heat exchanger in water-cooled systems.
4) Includes cooling blowers/pumps; largest unit shown. CPT: Control power transformer.
5) Percentage of transformer kVA.
6) Maximum installable size per phase.
7) PE - Protective Earth.
8) For dimension drawings please refer to Section 5, pg 5/11.
9) Drive Weight is based on cell cabinet, transformer cabinet, and coolant cabinet only.

Technical data (continued)

ROBICON Perfect Harmony liquid-cooled drive version		6SR3252-1.B47-0..0	6SR3252-1.B47-5..0	6SR3252-1.B48-0..0	6SR3252-1.B48-5..0
Motor voltage 4.6/4.8 kV					
Max. output voltage	kV	5.3	5.3	5.3	5.3
Type rating	kVA	6150	6590	7030	7315
Shaft output [1]	hp	7000	7500	8000	8328
	kW	5222	5595	5968	6213
Typical motor current [1]	A	739.67	792.50	845.34	880.00
Power cell current	A	880	880	880	880
Number of cells		12	12	12	12
Transformer rating	kVA	7000	7500	8000	8500
Power losses of drive system					
• Copper transformer	kW	< 245	< 263	< 280	< 298
Efficiency P_{out}/P_{in} [2] **of drive system**					
• Copper transformer	%	96.5	96.5	96.5	96.5
Auxiliary supply					
• Single-phase w/o options [3]	kVA	2.5	2.5	2.5	2.5
• Single-phase w/ all options [3]	kVA	2.5	2.5	2.5	2.5
• Three-phase w/o CPT [4]	kVA	25	25	25	25
• Three-phase w/ CPT and all -options [4]	kVA	27.5	27.5	27.5	27.5
System pre-charge [5]	%	< 0.5	< 0.5	< 0.5	< 0.5
Cooling water requirement	–	Determined by actual design of external liquid-to-air or liquid-to-liquid heat exchanger			
Power cabling cross sections [6]					
• Cable cross-sections, line-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500
• Cable cross-sections, motor-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500
• PE [7] connection, max. connection cross-section at enclosure with ½" bolt	AWG/MCM (NEC, CEC)	1000 MCM	1000 MCM	1000 MCM	1000 MCM
	mm^2 (DIN VDE)	500	500	500	500
Degree of protection	MV LV	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21
Drive dimensions (overall drive dimensions)					
• Width	in mm	406 10310	406 10310	406 10310	406 10310
• Height	in mm	115 2920	115 2920	115 2920	115 2920
• Depth	in mm	66 1680	66 1680	66 1680	66 1680
• Dimension drawing [8]		A	A	A	A
Drive weight (cell cabinet and transformer cabinet)					
• Weight [9]	lb kg	46608 21141	47468 21531	48300 21909	49107 22275

1) The Specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical power factor **cos** and motor efficiency. Both approximate values have to be adapted to the motor that is actually used.
2) Values at 100% of rated speed and torque; includes drive and input transformer.
3) 120/240 V AC for NXGII control and 120 V AC internal heat exchanger in water-cooled systems.
4) Includes cooling blowers/pumps; largest unit shown. CPT: Control power transformer.
5) Percentage of transformer kVA.
6) Maximum installable size per phase.
7) PE - Protective Earth.
8) For dimension drawings please refer to Section 5, pg 5/11.
9) Drive Weight is based on cell cabinet, transformer cabinet, and coolant cabinet only.

Technical data (continued)

ROBICON Perfect Harmony liquid-cooled drive version		6SR3252-1.C48-5..0	6SR3252-1.C48-7..0	6SR3252-1.C48-8..0	6SR3252-1.C52-0..0	6SR3252-1.C52-2..0	6SR3252-1.C52-4..0
Motor voltage 4.6/4.8 kV							
Max. output voltage	kV	5.3	5.3	5.3	5.3	5.3	5.3
Type rating	kVA	7470	7910	8350	8780	9660	10390
Shaft output [1]	hp kW	8500 6341	9000 6714	9500 7087	10000 7460	11000 8206	11830 8825
Typical motor current [1]	A	898.17	951.00	1003.84	1056.67	1162.34	1250.00
Power cell current	A	1250	1250	1250	1250	1250	1250
Number of cells		12	12	12	12	12	12
Transformer rating	kVA	8500	9000	9500	10000	11000	12000
Power losses of drive system • Copper transformer	kW	< 298	< 315	< 333	< 350	< 385	< 420
Efficiency P_{out}/P_{in} [2] **of drive system** • Copper transformer	%	96.5	96.5	96.5	96.5	96.5	96.5
Auxiliary supply							
• Single-phase w/o options [3]	kVA	2.5	2.5	2.5	2.5	2.5	2.5
• Single-phase w/ all options [3]	kVA	2.5	2.5	2.5	2.5	2.5	2.5
• Three-phase w/o CPT [4]	kVA	25	25	25	25	25	25
• Three-phase w/ CPT and all -options [4]	kVA	27.5	27.5	27.5	27.5	27.5	27.5
System pre-charge [5]	%	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cooling water requirement	—	Determined by actual design of external liquid-to-air or liquid-to-liquid heat exchanger					
Power cabling cross sections [6]							
• Cable cross-sections, line-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• Cable cross-sections, motor-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• PE [7] connection, max. connection cross-section at enclosure with ½" bolt	AWG/MCM (NEC, CEC)	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM
	mm^2 (DIN VDE)	500	500	500	500	500	500
Degree of protection	MV LV	NEMA 12/IP54 NEMA 1/IP21	NEMA 12/IP54 NEMA 1/IP21	NEMA 12/IP54 NEMA 1/IP21	NEMA 12/IP54 NEMA 1/IP21	NEMA 12/IP54 NEMA 1/IP21	NEMA 12/IP54 NEMA 1/IP21
Drive dimensions (overall drive dimensions)							
• Width	in mm	406 10310	406 10310	406 10310	412 10470	412 10470	412 10470
• Height	in mm	115 2920	115 2920	115 2920	115 2920	115 2920	115 2920
• Depth	in mm	66 1680	66 1680	66 1680	70 1780	70 1780	70 1780
• Dimension drawing [8]		A	A	A	A	A	A
Drive weight (cell cabinet and transformer cabinet)							
• Weight [9]	lb kg	50107 22729	50891 23084	51654 23430	52398 23768	53832 24418	55204 25041

1) The Specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical power factor ***cos*** and motor efficiency. Both approximate values have to be adapted to the motor that is actually used.
2) Values at 100% of rated speed and torque; includes drive and input transformer.
3) 120/240 V AC for NXGII control and 120 V AC internal heat exchanger in water-cooled systems.
4) Includes cooling blowers/pumps; largest unit shown. CPT: Control power transformer.
5) Percentage of transformer kVA.
6) Maximum installable size per phase.
7) PE - Protective Earth.
8) For dimension drawings please refer to Section 5, pg 5/11.
9) Drive Weight is based on cell cabinet, transformer cabinet, and coolant cabinet only.

Technical data (continued)

ROBICON Perfect Harmony liquid-cooled drive version		6SR3252-2.B47-0..0	6SR3252-2.B47-5..0	6SR3252-2.B48-0..0	6SR3252-2.B48-5..0	6SR3252-2.B48-7..0	6SR3252-2.B48-8..0
Motor voltage 6.0 kV							
Max. output voltage	kV	6.6	6.6	6.6	6.6	6.6	6.6
Type rating	kVA	6150	6590	7030	7470	7910	8350
Shaft output [1]	hp kW	7000 5222	7500 5595	8000 5968	8500 6341	9000 6714	9500 7087
Typical motor current [1]	A	591.74	634.00	676.27	718.54	760.80	803.07
Power cell current	A	880	880	880	880	880	880
Number of cells		15	15	15	15	15	15
Transformer rating	kVA	7000	7500	8000	8500	9000	9500
Power losses of drive system							
• Copper transformer	kW	< 245	< 263	< 280	< 298	< 315	< 333
Efficiency P_{out}/P_{in} [2] **of drive system**							
• Copper transformer	%	96.5	96.5	96.5	96.5	96.5	96.5
Auxiliary supply							
• Single-phase w/o options [3]	kVA	2.5	2.5	2.5	2.5	2.5	2.5
• Single-phase w/ all options [3]	kVA	2.5	2.5	2.5	2.5	2.5	2.5
• Three-phase w/o CPT [4]	kVA	25	25	25	25	25	25
• Three-phase w/ CPT and all -options [4]	kVA	27.5	27.5	27.5	27.5	27.5	27.5
System pre-charge [5]	%	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cooling water requirement	—	Determined by actual design of external liquid-to-air or liquid-to-liquid heat exchanger					
Power cabling cross sections [6]							
• Cable cross-sections, line-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• Cable cross-sections, motor-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• PE [7] connection, max. connection cross-section at enclosure with ½" bolt	AWG/MCM (NEC, CEC)	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM
	mm^2 (DIN VDE)	500	500	500	500	500	500
Degree of protection	MV LV	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 1/IP21 NEMA 12/ IP54	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/IP54 NEMA 1/IP21
Drive dimensions (overall drive dimensions)							
• Width	in mm	433 11100	433 11100	433 11100	433 11100	433 11100	433 11100
• Height	in mm	115 2920	115 2920	115 2920	115 2920	115 2920	115 2920
• Depth	in mm	66 1680	66 1680	66 1680	66 1680	66 1680	66 1680
• Dimension drawing [8]		**A**	**A**	**A**	**A**	**A**	**A**
Drive weight (cell cabinet and transformer cabinet)							
• Weight [9]	lb kg	49247 22338	50115 22732	50956 23114	51771 23483	52563 23843	53333 24192

1) The Specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical power factor **cos** and motor efficiency. Both approximate values have to be adapted to the motor that is actually used.
2) Values at 100% of rated speed and torque; includes drive and input transformer.
3) 120/240 V AC for NXGII control and 120 V AC internal heat exchanger in water-cooled systems.
4) Includes cooling blowers/pumps; largest unit shown. CPT: Control power transformer.
5) Percentage of transformer kVA.
6) Maximum installable size per phase.
7) PE - Protective Earth.
8) For dimension drawings please refer to Section 5, pg 5/11.
9) Drive Weight is based on cell cabinet, transformer cabinet, and coolant cabinet only.

Technical data (continued)

ROBICON Perfect Harmony liquid-cooled drive version		6SR3252-2.B52-0..0	6SR3252-2.B52-2..0	6SR3252-2.C52-2..0	6SR3252-2.C52-4..0	6SR3252-2.C52-6..0
Motor voltage 6.0						
Max. output voltage	kV	6.6	6.6	6.6	6.6	6.6
Type rating	kVA	8780	9140	9660	10540	11420
Shaft output [1]	hp kW	10000 7460	10410 7766	11000 8206	12000 8952	13000 9698
Typical motor current [1]	A	845.34	880.00	929.87	1014.40	1098.94
Power cell current	A	880	880	1250	1250	1250
Number of cells		15	15	15	15	15
Transformer rating	kVA	10000	11000	11000	12000	13000
Power losses of drive system • Copper transformer	kW	< 350	< 385	< 385	< 420	< 455
Efficiency P_{out}/P_{in} [2] **of drive system** • Copper transformer	% %	96.5	96.5	96.5	96.5	96.5
Auxiliary supply						
• Single-phase w/o options [3]	kVA	2.5	2.5	2.5	2.5	2.5
• Single-phase w/ all options [3]	kVA	2.5	2.5	2.5	2.5	2.5
• Three-phase w/o CPT [4]	kVA	25	25	25	25	25
• Three-phase w/ CPT and all -options [4]	kVA	27.5	27.5	27.5	27.5	27.5
System pre-charge [5]	%	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cooling water requirement	—	Determined by actual design of external liquid-to-air or liquid-to-liquid heat exchanger				
Power cabling cross sections [6] • Cable cross-sections, line-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC) mm^2 (DIN VDE)	2 x 1000 MCM 2 x 500	2 x 1000 MCM 2 x 500	2 x 100 MCM 2 x 500	2 x 1000 MCM 2 x 500	2 x 1000 MCM 2 x 500
• Cable cross-sections, motor-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC) mm^2 (DIN VDE)	2 x 1000 MCM 2 x 500	2 x 1000 MCM 2 x 500	2 x 1000 MCM 2 x 500	2 x 1000 MCM 2 x 500	2 x 1000 MCM 2 x 500
• PE [7] connection, max. connection cross-section at enclosure with ½" bolt	AWG/MCM (NEC, CEC) mm^2 (DIN VDE)	1000 MCM 500	1000 MCM 500	1000 MCM 500	1000 MCM 500	1000 MCM 500
Degree of protection	MV LV	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21
Drive dimensions (overall drive dimensions)						
• Width	in mm	439 11150	439 11150	439 11150	439 11150	439 11150
• Height	in mm	115 2920	115 2920	115 2920	115 2920	115 2920
• Depth	in mm	70 1780	70 1780	70 1780	70 1780	70 1780
• Dimension drawing [8]		A	A	A	A	A
Drive weight (cell cabinet and transformer cabinet)						
• Weight [9]	lb kg	54084 24533	55533 25190	55533 25190	56919 25818	58248 26421

1) The Specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical power factor ***cos*** and motor efficiency. Both approximate values have to be adapted to the motor that is actually used.
2) Values at 100% of rated speed and torque; includes drive and input transformer.
3) 120/240 V AC for NXGII control and 120 V AC internal heat exchanger in water-cooled systems.
4) Includes cooling blowers/pumps; largest unit shown. CPT: Control power transformer.
5) Percentage of transformer kVA.
6) Maximum installable size per phase.
7) PE - Protective Earth.
8) For dimension drawings please refer to Section 5, pg 5/11.
9) Drive Weight is based on cell cabinet, transformer cabinet, and coolant cabinet only.

Technical data (continued)

ROBICON Perfect Harmony liquid-cooled drive version		6SR3252-2.C52-8..0	6SR3252-2.C53-0..0
Motor voltage 6.0 kV			
Max. output voltage	kV	6.6	6.6
Type rating	kVA	12300	12990
Shaft output [1]	hp	14000	14787
	kW	10444	11031
Typical motor current [1]	A	1183.47	1250.00
Power cell current	A	1250	1250
Number of cells		15	15
Transformer rating	kVA	14000	15000
Power losses of drive system			
• Copper transformer	kW	< 490	< 525
Efficiency P_{out}/P_{in} [2] **of drive system**			
• Copper transformer	%	96.5	96.5
Auxiliary supply			
• Single-phase w/o options [3]	kVA	2.5	2.5
• Single-phase w/ all options [3]	kVA	2.5	2.5
• Three-phase w/o CPT [4]	kVA	25	25
• Three-phase w/ CPT and all - options [4]	kVA	27.5	27.5
System pre-charge [5]	%	< 0.5	< 0.5
Cooling water requirement	–	Determined by actual design of external liquid-to-air or liquid-to-liquid heat exchanger	
Power cabling cross sections [6]			
• Cable cross-sections, line-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500
• Cable cross-sections, motor-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500
• PE [7] connection, max. connection cross-section at enclosure with ½" bolt	AWG/MCM (NEC, CEC)	1000 MCM	1000 MCM
	mm^2 (DIN VDE)	500	500
Degree of protection	MV LV	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21
Drive dimensions (overall drive dimensions)			
• Width	in mm	439 11150	439 11150
• Height	in mm	115 2920	115 2920
• Depth	in mm	70 1780	70 1780
• Dimension drawing [8]		**A**	**A**
Drive weight (cell cabinet and transformer cabinet)			
• Weight [9]	lb kg	59529 27002	60766 27563

1) The Specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical power factor ***cos*** and motor efficiency. Both approximate values have to be adapted to the motor that is actually used.
2) Values at 100% of rated speed and torque; includes drive and input transformer.
3) 120/240 V AC for NXGII control and 120 V AC internal heat exchanger in water-cooled systems.
4) Includes cooling blowers/pumps; largest unit shown. CPT: Control power transformer.
5) Percentage of transformer kVA.
6) Maximum installable size per phase.
7) PE - Protective Earth.
8) For dimension drawings please refer to Section 5, pg 5/11.
9) Drive Weight is based on cell cabinet, transformer cabinet, and coolant cabinet only.

Technical data (continued)

ROBICON Perfect Harmony liquid-cooled drive version		6SR3252-2.B48-0..0	6SR3252-2.B48-5..0	6SR3252-2.B48-7..0	6SR3252-2.B48-8..0	6SR3252-2.B52-0..0	6SR3252-2.B52-2..0	6SR3252-2.B52-4..0
Motor voltage 6.6 kV								
Max. output voltage	kV	6.6	6.6	6.6	6.6	6.6	6.6	6.6
Type rating	kVA	7030	7470	7910	8350	8780	9660	10055
Shaft output [1]	hp kW	8000 5968	8500 6341	9000 6714	9500 7087	10000 7460	11000 8206	11450 8542
Typical motor current [1]	A	614.79	653.21	691.64	730.06	768.49	845.34	880.00
Power cell current	A	880	880	880	880	880	880	880
Number of cells		15	15	15	15	15	15	15
Transformer rating	kVA	8000	8500	9000	9500	10000	11000	12000
Power losses of drive system • Copper transformer	kW	< 280	< 298	< 315	< 333	< 350	< 385	< 420
Efficiency P_{out}/P_{in} [2] **of drive system** • Copper transformer	%	96.5	96.5	96.5	96.5	96.5	96.5	96.5
Auxiliary supply								
• Single-phase w/o options [3]	kVA	2.5	2.5	2.5	2.5	2.5	2.5	2.5
• Single-phase w/ all options [3]	kVA	2.5	2.5	2.5	2.5	2.5	2.5	2.5
• Three-phase w/o CPT [4]	kVA	25	25	25	25	25	25	25
• Three-phase w/ CPT and all -options [4]	kVA	27.5	27.5	27.5	27.5	27.5	27.5	27.5
System pre-charge [5]	%	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cooling water requirement	—	Determined by actual design of external liquid-to-air or liquid-to-liquid heat exchanger						
Power cabling cross sections [6]								
• Cable cross-sections,line-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC,CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• Cable cross-sections, motor-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• PE [7] connection, max. connection cross-section at enclosure with ½" bolt	AWG/MCM (NEC, CEC)	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM
	mm^2 (DIN VDE)	500	500	500	500	500	500	
Degree of protection	MV LV	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21
Drive dimensions (overall drive dimensions)								
• Width	in mm	433 11100	433 11100	433 11100	433 11100	439 11150	439 11150	439 11150
• Height	in mm	115 2920	115 2920	115 2920	115 2920	115 2920	115 2920	115 2920
• Depth	in mm	66 1680	66 1680	66 1680	66 1680	70 1780	70 1780	70 1780
• Dimension drawing [8]		A	A	A	A	A	A	A
Drive weight (cell cabinet and transformer cabinet)								
• Weight [9]	lb kg	50956 23114	51771 23483	52563 23843	53333 24192	54084 24533	55533 25190	56919 25818

1) The Specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical power factor ***cos*** and motor efficiency. Both approximate values have to be adapted to the motor that is actually used.
2) Values at 100% of rated speed and torque; includes drive and input transformer.
3) 120/240 V AC for NXGII control and 120 V AC internal heat exchanger in water-cooled systems.
4) Includes cooling blowers/pumps; largest unit shown. CPT: Control power transformer.
5) Percentage of transformer kVA.
6) Maximum installable size per phase.
7) PE - Protective Earth.
8) For dimension drawings please refer to Section 5, pg 5/11.
9) Drive Weight is based on cell cabinet, transformer cabinet, and coolant cabinet only.

Technical data (continued)

ROBICON Perfect Harmony liquid-cooled drive version		6SR3252-2.C52-4..0	6SR3252-2.C52-6..0	6SR3252-2.C52-8..0	6SR3252-2.C53-0..0	6SR3252-2.C53-2..0	6SR3252-2.C53-4..0
Motor voltage 6.6 kV							
Max. output voltage	kV	6.6	6.6	6.6	6.6	6.6	6.6
Type rating	kVA	10540	11420	12300	13180	14060	14285
Shaft output [1]	hp kW	12000 8952	13000 9698	14000 10444	15000 11190	16000 11936	16266 12134
Typical motor current [1]	A	922.19	999.03	1075.88	1152.73	1229.58	1250.00
Power cell current	A	1250	1250	1250	1250	1250	1250
Number of cells		15	15	15	15	15	15
Transformer rating	kVA	12000	13000	14000	15000	16000	17000
Power losses of drive system • Copper transformer	kW	< 420	< 455	< 490	< 525	< 560	< 595
Efficiency P_{out}/P_{in} [2] **of drive system** • Copper transformer	%	96.5	96.5	96.5	96.5	96.5	96.5
Auxiliary supply							
• Single-phase w/o options [3]	kVA	2.5	2.5	2.5	2.5	2.5	2.5
• Single-phase w/ all options [3]	kVA	2.5	2.5	2.5	2.5	2.5	2.5
• Three-phase w/o CPT [4]	kVA	25	25	25	25	25	25
• Three-phase w/ CPT and all -options [4]	kVA	27.5	27.5	27.5	27.5	27.5	27.5
System pre-charge [5]	%	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cooling water requirement	—	Determined by actual design of external liquid-to-air or liquid-to-liquid heat exchanger					
Power cabling cross sections [6]							
• Cable cross-sections, line-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• Cable cross-sections, motor-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• PE [7] connection, max. connection cross-section at enclosure with ½" bolt	AWG/MCM (NEC, CEC)	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM
	mm^2 (DIN VDE)	500	500	500	500	500	500
Degree of protection	MV LV	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/IP54 NEMA 1/IP21
Drive dimensions (overall drive dimensions)							
• Width	in mm	439 11150	439 11150	439 11150	439 11150	439 11150	439 11150
• Height	in mm	115 2920	115 2920	115 2920	115 2920	115 2920	115 2920
• Depth	in mm	70 1780	70 1780	70 1780	70 1780	70 1780	70 1780
• Dimension drawing [8]		A	A	A	A	A	A
Drive weight (cell cabinet and transformer cabinet)							
• Weight [9]	lb kg	56919 25818	58248 26421	59529 27002	60766 27563	61963 28106	63123 28633

1) The Specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical power factor ***cos*** and motor efficiency. Both approximate values have to be adapted to the motor that is actually used.
2) Values at 100% of rated speed and torque; includes drive and input transformer.
3) 120/240 V AC for NXGII control and 120 V AC internal heat exchanger in water-cooled systems.
4) Includes cooling blowers/pumps; largest unit shown. CPT: Control power transformer.
5) Percentage of transformer kVA.
6) Maximum installable size per phase.
7) PE - Protective Earth.
8) For dimension drawings please refer to Section 5, pg 5/11.
9) Drive Weight is based on cell cabinet, transformer cabinet, and coolant cabinet only.

Technical data (continued)

ROBICON Perfect Harmony liquid-cooled drive version		6SR3252-3.B48-0..0	6SR3252-3.B48-5..0	6SR3252-3.B48-7..0	6SR3252-3.B48-8..0	6SR3252-3.B52-0..0
Motor voltage 6.9/7.2 kV						
Max. output voltage	kV	8.0	8.0	8.0	8.0	8.0
Type rating	kVA	7030	7470	7910	8350	8780
Shaft output [1]	hp kW	8000 5968	8500 6341	9000 6714	9800 7087	10000 7460
Typical motor current [1]	A	563.56	598.78	634.00	669.22	704.45
Power cell current	A	880	880	880	880	880
Number of cells		18	18	18	18	18
Transformer rating	kVA	8000	8500	9000	9500	10000
Power losses of drive system • Copper transformer	kW	< 280	< 298	< 315	< 333	< 350
Efficiency P_{out}/P_{in} [2] **of drive system** • Copper transformer	%	96.5	96.5	96.5	96.5	96.5
Auxiliary supply						
• Single-phase w/o options [3]	kVA	2.5	2.5	2.5	2.5	2.5
• Single-phase w/ all options [3]	kVA	2.5	2.5	2.5	2.5	2.5
• Three-phase w/o CPT [4]	kVA	25	25	25	25	25
• Three-phase w/ CPT and all -options [4]	kVA	27.5	27.5	27.5	27.5	27.5
System pre-charge [5]	%	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cooling water requirement	—	Determined by actual design of external liquid-to-air or liquid-to-liquid heat exchanger				
Power cabling cross sections [6] • Cable cross-sections, line-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• Cable cross-sections, motor-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• PE [7] connection, max. connection cross-section at enclosure with ½" bolt	AWG/MCM (NEC, CEC)	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM
	mm^2 (DIN VDE)	500	500	500	500	500
Degree of protection	MV LV	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21
Drive dimensions (overall drive dimensions)						
• Width	in mm	468 11890	468 11890	468 11890	468 11890	474 12040
• Height	in mm	115 2920	115 2920	115 2920	115 2920	115 2920
• Depth	in mm	66 1680	66 1680	66 1680	66 1680	70 1780
• Dimension drawing [8]		A	A	A	A	A
Drive weight (cell cabinet and transformer cabinet)						
• Weight [9]	lb kg	61609 27946	62432 28319	63232 28682	64010 29035	64768 29379

1) The Specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical power factor ***cos*** and motor efficiency. Both approximate values have to be adapted to the motor that is actually used.
2) Values at 100% of rated speed and torque; includes drive and input transformer.
3) 120/240 V AC for NXGII control and 120 V AC internal heat exchanger in water-cooled systems.
4) Includes cooling blowers/pumps; largest unit shown. CPT: Control power transformer.
5) Percentage of transformer kVA.
6) Maximum installable size per phase.
7) PE - Protective Earth.
8) For dimension drawings please refer to Section 5, pg 5/11.
9) Drive Weight is based on cell cabinet, transformer cabinet, and coolant cabinet only.

Technical data (continued)

ROBICON Perfect Harmony liquid-cooled drive version		6SR3252-3.B48-0..0	6SR3252-3.B48-5..0	6SR3252-3.B48-7..0	6SR3252-3.B48-8..0	6SR3252-3.B52-0..0
Motor voltage 6.9/7.2 kV						
Max. output voltage	kV	8.0	8.0	8.0	8.0	8.0
Type rating	kVA	9660	10540	10970	11420	12300
Shaft output [1]	hp kW	11000 8206	12000 8952	12492 9319	13000 9698	14000 10444
Typical motor current [1]	A	774.89	845.34	880.00	915.78	986.23
Power cell current	A	880	880	880	1250	1250
Number of cells		18	18	18	18	18
Transformer rating	kVA	11000	12000	13000	13000	14000
Power losses of drive system • Copper transformer	kW	< 385	< 420	< 455	< 455	< 490
Efficiency P_{out}/P_{in} [2] **of drive system** • Copper transformer	%	96.5	96.5	96.5	96.5	96.5
Auxiliary supply						
• Single-phase w/o options [3]	kVA	2.5	2.5	2.5	2.5	2.5
• Single-phase w/ all options [3]	kVA	2.5	2.5	2.5	2.5	2.5
• Three-phase w/o CPT [4]	kVA	25	25	25	25	25
• Three-phase w/ CPT and all -options [4]	kVA	27.5	27.5	27.5	27.5	27.5
System pre-charge [5]	%	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cooling water requirement	—	Determined by actual design of external liquid-to-air or liquid-to-liquid heat exchanger				
Power cabling cross sections [6] • Cable cross-sections, line-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• Cable cross-sections, motor-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500	2 x 500
• PE [7] connection, max. connection cross-section at enclosure with ½" bolt	AWG/MCM (NEC, CEC)	1000 MCM	1000 MCM	1000 MCM	1000 MCM	1000 MCM
	mm^2 (DIN VDE)	500	500	500	500	500
Degree of protection	MV LV	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21
Drive dimensions (overall drive dimensions)						
• Width	in mm	474 12040	474 12040	474 12040	474 12040	478 12140
• Height	in mm	115 2920	115 2920	115 2920	115 2920	125 3180
• Depth	in mm	70 1780	70 1780	70 1780	70 1780	76 1930
• Dimension drawing [8]		A	A	A	A	A
Drive weight (cell cabinet and transformer cabinet)						
• Weight [9]	lb kg	66231 30042	67630 30677	68973 31286	68973 31286	70266 31873

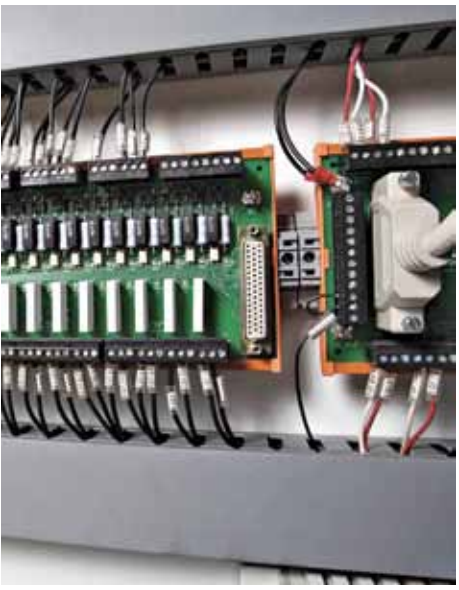
1) The Specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical power factor ***cos*** and motor efficiency. Both approximate values have to be adapted to the motor that is actually used.
2) Values at 100% of rated speed and torque; includes drive and input transformer.
3) 120/240 V AC for NXGII control and 120 V AC internal heat exchanger in water-cooled systems.
4) Includes cooling blowers/pumps; largest unit shown. CPT: Control power transformer.
5) Percentage of transformer kVA.
6) Maximum installable size per phase.
7) PE - Protective Earth.
8) For dimension drawings please refer to Section 5, pg 5/11.
9) Drive Weight is based on cell cabinet, transformer cabinet, and coolant cabinet only.

Technical data (continued)

ROBICON Perfect Harmony liquid-cooled drive version		6SR3252-3.C53-0..0	6SR3252-3.C53-2..0	6SR3252-3.C53-4..0	6SR3252-3.C53-6..0
Motor voltage 6.9/7.2 kV					
Max. output voltage	kV	8.0	8.0	8.0	8.0
Type rating	kVA	13180	14060	14930	15585
Shaft output [1]	hp kW	15000 11190	16000 11936	17000 12682	17744 13237
Typical motor current [1]	A	1056.67	1127.12	1197.56	1250.00
Power cell current	A	1250	1250	1250	1250
Number of cells		18	18	18	18
Transformer rating	kVA	15000	16000	17000	18000
Power losses of drive system • Copper transformer	kW	< 525	< 560	< 595	< 630
Efficiency P_{out}/P_{in} [2] **of drive system** • Copper transformer	%	96.5	96.5	96.5	96.5
Auxiliary supply					
• Single-phase w/o options [3]	kVA	2.5	2.5	2.5	2.5
• Single-phase w/ all options [3]	kVA	2.5	2.5	2.5	2.5
• Three-phase w/o CPT [4]	kVA	25	25	25	25
• Three-phase w/ CPT and all -options [4]	kVA	27.5	27.5	27.5	27.5
System pre-charge [5]	%	< 0.5	< 0.5	< 0.5	< 0.5
Cooling water requirement	—	Determined by actual design of external liquid-to-air or liquid-to-liquid heat exchanger			
Power cabling cross sections [6] • Cable cross-sections, line-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500
• Cable cross-sections, motor-side, max. connectable per phase with ½" bolt	AWG/MCM (NEC, CEC)	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM	2 x 1000 MCM
	mm^2 (DIN VDE)	2 x 500	2 x 500	2 x 500	2 x 500
• PE [7] connection, max. connection cross-section at enclosure with ½" bolt	AWG/MCM (NEC, CEC)	1000 MCM	1000 MCM	1000 MCM	1000 MCM
	mm^2 (DIN VDE)	500	500	500	500
Degree of protection	MV LV	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21	NEMA 12/ IP54 NEMA 1/IP21
Drive dimensions (overall drive dimensions)					
• Width	in mm	478 12140	478 12140	478 12140	478 12140
• Height	in mm	125 3180	125 3180	125 3180	125 3180
• Depth	in mm	76 1930	76 1930	76 1930	76 1930
• Dimension drawing [8]		A	A	A	A
Drive weight (cell cabinet and transformer cabinet)					
• Weight [9]	lb kg	71515 32429	72723 32987	73895 33519	75034 34035

1) The Specifications for the typical motor current and the power data in hp and kW are approximate values only; these have been calculated for operation with induction motors and for a typical power factor ***cos*** and motor efficiency. Both approximate values have to be adapted to the motor that is actually used.
2) Values at 100% of rated speed and torque; includes drive and input transformer.
3) 120/240 V AC for NXGII control and 120 V AC internal heat exchanger in water-cooled systems.
4) Includes cooling blowers/pumps; largest unit shown. CPT: Control power transformer.
5) Percentage of transformer kVA.
6) Maximum installable size per phase.
7) PE - Protective Earth.
8) For dimension drawings please refer to Section 5, pg 5/11.
9) Drive Weight is based on cell cabinet, transformer cabinet, and coolant cabinet only.

Notes



Description of Options

Options

Below you will find a detailed description of the options available. To easily find the required order code and its associated parameters, the descriptions are sorted alphabetically by order codes in the paragraphs below.

A30, A31
Keypad, Touch Screen

Option	Description
A30	**Touchscreen with standard cable** Standard Siemens touchscreen with standard Ethernet cable will be provided on the door of the drive. Option A30 includes option **N85** (Keypad located internal to cabinet).

A60 to A65
Motor Monitoring

Note: The options **A60** to **A65** are mutually exclusive. Select one of them only.

Option	Description
A60	**TEC System RTD monitor** Basic 8-channel RTD monitor
A61	**Multilin 369 motor protection relay** Motor protection/management relay with only 12-channel RTD monitoring capability installed. This is provided on the output of the drive.
A62	**Multilin 369 motor protection relay with metering kit** Motor protection/management relay with 12-channel RTD monitoring capability installed. This is provided on the output of the drive.
A63	**Multilin 469 motor protection relay** Full featured high-end motor protection / management relay with miscellaneous sensors monitoring capability installed. This is provided on the output of the drive.
A64	**Siemens 7UM61 motor protection relay** Motor protection/management relay with Siemens 7UM61. This is provided on the output of the drive.
A65	**Siemens 7UM62 motor protection relay** Motor protection/management relay with Siemens 7UM62. This is provided on the output of the drive.

A66
Sync check relay for synchronizing

With option **A66**, a sync check relay for synchronizing the input and output voltage and frequency during synchronous transfer operation is mounted on the right door.

A67, A69
Power quality monitoring

Option	Description
A67	**Multilin input power quality meter** Multilin power quality meter installed at the input of the drive.
A69	**Siemens 9510 input power quality meter** Siemens power quality meter installed at the input of the drive

B43 to B45
Production Schedules

The options **B43** to **B45** provide production schedule documents. These are sent via E-Mail as PDF files in English after order clarification.

Option	Description
B43	**Production schedule: One issue**
B44	**Production schedule: updated at 2-week intervals**
B45	**Production schedule: updated once per month**

Table 3-1 Mutually exclusive options **B43** to **B45**

Production Schedules	Code	B43	B44	B45
Production schedule: One issue	**B43**		—	—
Production schedule: updated at 2-week intervals	**B44**	—		—
Production schedule: updated once per month.	**B45**	—	—	

— Options are mutually exclusive

Options

D00 to D90
Documentation

The standard documentation is supplied in English on CD-ROM. The circuit diagrams / terminal diagrams are available only in English.

Note: Please contact the factory or your local Siemens sales representative for documentation in a language different from the ones specified below.

Option	Description
D00	**Documentation in German** With order code **D00**, the documentation is supplied in German on CD-ROM.
D02	**Circuit diagrams, terminal diagrams and dimension drawings in DXF format (English only)** Documents such as circuit diagrams, terminal diagrams, the arrangement diagram and the dimension drawing can be ordered with order code **D02** in DXF format, e.g. for use in AutoCAD systems.
D15	**One set of printed documentation (multiple orders possible)** If documentation is also required on paper, this must be ordered using order code **D15**.
D54	**Documentation in Czech (on request)**
D55	**Documentation in Polish (on request)**
D56	**Documentation in Russian** With order code **D56**, the documentation is supplied in Russian on CD-ROM.
D57	**Documentation in Japanese (on request)**
D62	**Documentation in Danish (on request)**
D71	**Documentation in Romanian (on request)**
D72	**Documentation in Italian (on request)**
D73	**Documentation in Finnish (on request)**
D74	**Documentation in Dutch (on request)**
D75	**Documentation in Turkish (on request)**
D76	**Documentation in English** If a documentation language other than English is selected (options **D00** or **D56** to **D84**), an additional CD-ROM with documentation in English as second documentation language can be ordered using order code **D76**. Note: If option **D15** (one set of printed documentation) is selected simultaneously, the printed documentation will be delivered in the first documentation language only.
D77	**Documentation in French (on request)**
D78	**Documentation in Spanish (on request)**
D79	**Documentation in Portuguese (Brazil)** With order code **D79**, the documentation is supplied in Portuguese on CD-ROM.
D80	**Documentation in Bulgarian (on request)**
D81	**Documentation in Norwegian (on request)**
D82	**Documentation in Hungarian (on request)**
D83	**Documentation in Swedish (on request)**
D84	**Documentation in Chinese** With order code **D84**, the documentation is supplied in Chinese on CD-ROM.
D85	**Documentation in Slovenian (on request)**
D86	**Documentation in Greek (on request)**
D87	**Documentation in Slovakian (on request)**
D88	**Documentation in Estonian (on request)**
D89	**Documentation in Latvian (on request)**
D90	**Documentation in Lithuanian (on request)**

Table 3-2 Mutually exclusive options **D00** to **D84**
Documentation
(standard PDF format in English on CD-ROM)

Documentation	Code	D00	D02	D15	D56	D76	D79	D84
Documentation in German	**D00**		✓	✓	—	✓	—	—
Circuit Diagrams, terminal diagrams and dimension drawings in DXF format (English only)	**D02**	✓		✓	✓	✓	✓	✓
One set of printed documentation	**D15**	✓	✓		✓	✓	✓	✓
Documentation in Russian	**D56**	—	✓	✓		✓	—	—
Documentation in English	**D76**	✓	✓	✓	✓		✓	✓
Documentation in Portuguese (Brazil)	**D79**	—	✓	✓	—	✓		—
Documentation in Chinese	**D84**	—	✓	✓	—	✓	—	

✓ Options can be combined

— Options are mutually exclusive

E00, E01
Motor Static Exciter

Option	Description
E00	**Motor static exciter furnished by customer** Option **E00** should be selected when customer will be supplying the static exciter cabinet for synchronous motor applications.
E01	**Motor static exciter furnished by Siemens** For synchronous motor applications, the static exciter cabinet will be provided by Siemens as part of the drive lineup with the same degree of protection as the drive.

Options

G21 to G93
Serial communication

Option	Description
G21	**Modbus Plus interface, network 1** Note: If a second Modbus Plus interface is required, select options **G21** and **G31**
G22	**Modbus RTU interface, network 1** Software activation of the interface; available without additional hardware. Note: If a second Modbus interface is required, select options **G22** and **G32**.
G23	**DeviceNet profile 12 interface, network 1** Note: If a second DeviceNet interface is required, select options **G23** and **G43**.
G26	**Control Net interface, network 1** Note: If second Control Net interface is required, select options **G26** and **G46**.
G28	**Modbus Ethernet interface, network 1** Software activation of the interface; available without additional hardware. Note: If a second Modbus Ethernet interface is required, select option **G28** and **G38**.
G31	**Modbus Plus interface, network 2**
G32	**Modbus RTU interface, network 2**
G38	**Modbus Ethernet interface, network 2**
G43	**DeviceNet profile 12 interface, network 2**
G46	**Control Net interface, network 2**
G91	**PROFIBUS DP interface, network 1** Note: If a second PROFIBUS DP interface is required, select option **G91** and **G93**.
G93	**PROFIBUS DP interface, network 2**

Table 3-4 # of Anybus modules required for network implementation using NXGII

Network 1 \ Network 2	Modbus Plus (G21)	Modbus RTU [1] (G22)	DeviceNet profile 12 (G23)	Control Net (G26)	Modbus Ethernet [2] (G28)	PROFIBUS DP (G91)
Modbus Plus **(G21)**	2	2	2	2	2	2
Modbus RTU [1] **(G22)**	1	1	1	1	1	1
DeviceNet profile 12 **(G23)**	2	2	2	2	2	2
Control Net **(G26)**	2	2	2	2	2	1
Modbus Ethernet [2] **(G28)**	1	1	1	1	1	1
PROFIBUS DP **(G91)**	2	2	2	2	2	2

[1] Network 1 Modbus RTU uses the COM port on the communications board.
[2] Network 1 Modbus Ethernet uses the Ethernet port on the CPU card (additional Ethernet switch is required).

Table 3-4 Mutually exclusive options (G21 to G93)

Serial communication	Code	G21	G22	G23	G26	G28	G91	G31	G32	G38	G43	G46	G93
Modbus Plus interface, network 1	G21		—	—	—	—	—	✓	✓	✓	✓	✓	✓
Modbus RTU interface, network 1	G22	—		—	—	—	—	✓	✓	✓	✓	✓	✓
DeviceNet profile 12 interface, network 1	G23	—	—		—	—	—	✓	✓	✓	✓	✓	✓
Control Net interface, network 1	G26	—	—	—		—	—	✓	✓	✓	✓	✓	✓
Modbus Ethernet interface, network 1	G28	—	—	—	—		—	✓	✓	✓	✓	✓	✓
PROFIBUS DP interface, network 1	G91	—	—	—	—	—		✓	✓	✓	✓	✓	✓
Modbus Plus interface, network 2	G31	✓	✓	✓	✓	✓	✓		—	—	—	—	—
Modbus RTU interface, network 2	G32	✓	✓	✓	✓	✓	✓	—		—	—	—	—
Modbus Ethernet interface, network 2	G38	✓	✓	✓	✓	✓	✓	—	—		—	—	—
DeviceNet profile 12 interface, network 2	G43	✓	✓	✓	✓	✓	✓	—	—	—		—	—
Control Net interface, network 2	G46	✓	✓	✓	✓	✓	✓	—	—	—	—		—
PROFIBUS DP interface, network 2	G93	✓	✓	✓	✓	✓	✓	—	—	—	—	—	

✓ Options can be combined

— Options are mutually exclusive

G42
Network communication

Option	Description
G42	**Ethernet network switch with fiber optic port**

G47
Ethernet port connector mounted on the door

The Ethernet port connector is standard for all Perfect Harmony Drives.

G89
Digital relay contact for control of external auxiliaries

WAGO terminal module: digital relay contact.

Options

K31, K33
Control and display instruments in the door

Option	Description
K31	**Off-Local-Remote selector** A three position selector switch mounted on the front of the drive. Note: The options **K31** to **K34** are mutually exclusive. Select one of them.
K33	**Keyed Off-Local-Remote selector** A three position selector switch mounted on the front of the drive provided with keyed protection. Note: The options **K31** and **K33** are mutually exclusive. Select one of them.

Note: Select one of the options **K31** and **K33**. Option **K31** is the preset value.

Drive Acceptance Tests in Presence of Customer	Code	K31	K33
Off-Local-Remote Selector	**K31**		—
Keyed Off-Local-Remote Selector	**K33**	—	

— Options are mutually exclusive

K50
Vector control with speed encoder

With option **K50**, I/O evaluation of a speed encoder signal is integrated. For example, this is used in applications that require very accurate speed control, especially at low speeds.

Note: Option **K50** is applied to speed encoder applications. Option K50 is not available for Permanent Magnet Motors (PMM) applications.

Available speed accuracy up to 0.1% rated speed.

K73, K79
Auxiliary and control voltage supply

With option **K73**, you can select a 24 V DC I/O voltage.

With option **K79**, the power source is defined. Select one of them. The internal control voltage will be 120 V AC in this case.

Option	Description
K73	**I/O signal voltage 24 V DC** With option **K73**, 24 V DC is available as Input/Output control signals
K79	**Connection for control voltage 120 V AC by customer** Using option **K79**, the customer will provide control voltage to the drive

L03
EMC Filter

CE mark drives require an EMC line filter. With option **L03**, the filter will be installed downstream from the 3-phase control power disconnect switch. Customer input control power cables will be routed inside the metallic wire-way before being terminated at the control power disconnect switch.

Note: Option **L03** is included by option **U02** (Version with CE conformity). It is not available separately for WCIII drives.

L09
Output reactor

For liquid-cooled units, as a standard, the liquid-cooled reactor cabinet will be included in the drive lineup with IP protection same as power section of the drive (IP54).

L29
Bidirectional synchronized transfer

Option **L29** offers automatic synchronization with seamless transfer of the motor to the line and take-over of the motor from the line. The drive synchronizes the motor to the supply voltage (phase relation, frequency and amplitude). The motor is subsequently connected in parallel to the line with the S3 circuit-breaker/contactor before the output-side S2 circuit-breaker/ contactor opens.

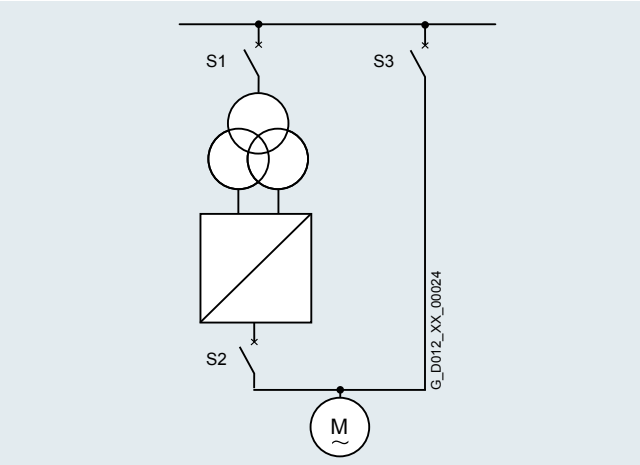


Figure 4-1 Circuit-breakers/contactors

Options

The opening and closing time of the two circuit-breakers / contactors is approximately 100 ms. Within this period of time, the motor is transferred from the drive to the line. This small time window allows for a bumpless transfer.

If the motor is to be taken from the line and operated via the drive, the transfer process is executed in reverse order. The circuit breaker contactor S2 is closed, the drive synchronizes to the output voltage, and magnetization current and up to 25% torque is applied. At this point, contactor S3 is opened and the motor is operating on the drive. This technique provides for minimum transient when transferring a motor from the line to the drive.

Synchronous transfer as implemented by ROBICON Perfect Harmony does not produce any high starting and transient torques that could damage the drive train or cause pressure fluctuations in the process. The S3 circuit-breaker/contactor must be configured to protect the motor against over currents and over voltages during line operation. If temperature sensors are fitted in the motor, these must be monitored independently (plant-side) during line operation. In addition, an output reactor (option L09) is required for the decoupling of the drive output during the commutation process.

Note: The circuit-breakers/contactors are not included in the scope of delivery. For the dimensioning of the output reactor (option **L09**) and the circuit-breakers/contactors contact the factory or your local Siemens sales representative. A motor protection relay should also be considered in the bypass circuit.

Attention: Option **L29** is only possible if the drive output voltage is the same as the line voltage.

L55
Anti-condensation heating for cabinet

The anti-condensation heating is recommended at low ambient temperatures and high levels of humidity to prevent condensation. The number of cabinet heaters fitted depends on the number of cabinet panels (refer to the table). The anti-condensation heaters are controlled with a thermostat.

Note: The supply voltage for the anti-condensation heating (110 or 240 V AC) **must** be supplied externally.

WCIII, number of cells	Number and power of heaters
9 to 12 cells	7 heaters, 250 W each
15 cells	8 heaters, 250 W each
18 cells	9 heaters, 250 W each

M08 to M10, M38
Mechanical door interlocks

With options **M08, M09, M10** and **M38** the drive is supplied with a mechanical door interlock system. These options are mutually exclusive.

Note: One of the options **M08** to **M10** and **M38** is required for CSA, CE (US).

Option	Description
M08	**Mechanical door interlock – Superior** Description see option **M10**.
M09	**Mechanical door interlock – Kirk** Description see option **M10**.
M10	**Mechanical door interlock – Castell** The safety closing/interlocking system is based on the key transfer system from Castell. The opened circuit-breaker releases the key to the key exchange unit, which in turn releases the keys to the drive cabinet doors of the power section. This ensures that the drive is isolated from the medium voltage and that the medium voltage is no longer present in to cabinet.
M38	**Mechanical door interlock – Fortress** Description see option M10.

Note: Options **M08, M09, M10** and **M38** are mutually exclusive, **M08** is the preset value.

Options

M17
Electrical door interlocks

The electrical switch doors interlock removes power from energized sectors.

Drive sends a signal to the circuit breaker trip circuit to remove power and to prevent closure of the circuit breaker. This system prevents the drive from being energized until all doors into the energized sections in the drive are closed. This system is a backup to the mechanical door interlocks (M08, M09, M10, and M38).

Note: **M17** is included by option U02 (Version with CE conformity. It is not available separately for these drives.

This system is a backup to the mechanical door interlocks (**M08, M09, M10,** and **M38**).

M36, M37
Gland plates

With options **M36** and **M37**, gland plates can be ordered in a brass (**M36**) and stainless steel (**M37**) version.

The options M36 and M37 are mutually exclusive.

Option	Description
M36	**Gland plates, brass**
M37	**Gland plates, stainless steel**

Note: Options M36 and M37 apply for input/output power cables only. Gland plates for control cables are always aluminum.

N26
Synchronized pre-charge pre-magnetization of the transformer

Liquid-cooled Perfect Harmony drives come equipped as standard with an asynchronous pre-charge system that will bring the DC-link capacitors in all power cells up to rated voltage before the incoming circuit-breaker is closed. Even with all the power cells pre-energized, the input transformer will still draw the characteristic inrush currents associated with distribution transformers of this size when energized.

The synchronized pre-charge option allows not only the DC-link capacitors in all power cells to be pre-charged, but in addition, to build-up the input transformer flux in close phase relation with the incoming medium voltage feed, hence minimizing the transformer inrush currents when the circuit-breaker is closed.

N85
Keypad located internal to cabinet

Keypad installed on the control panel inside the drive cabinet, no touchscreen provided.

T03, T04
Nameplate color, material

Option	Description
T03	**White letters with black core** (standard: black letters, white core)
T04	**Stainless steel** (standard: phenolic)

T74 to T91
Nameplate languages

Nameplates can be supplied in two languages. The following order codes provide a list of available languages.

Note: Please contact the factory or local Siemens sales representative for languages different from the ones specified below.

Option	Description
T74	**English / German**
T82	**English / Portuguese (Brazil)**
T85	**English / Russian**
T91	**English / Chinese**

Table 3-6 Mutually exclusive options T74 to T91

Nameplate language	Code	T74	T82	T85	T91
English / German	**T74**		—	—	—
English / Portuguese (Brazil)	**T82**	—		—	—
English / Russian	**T85**	—	—		—
English / Chinese	**T91**	—	—	—	

— Options are mutually exclusive.

U02
Version with CE conformity

With option **U02**, a drive version with CE conformity is supplied.

Note: Option **U02** includes options **L03** (EMC filter) and **M08** (mechanical door interlocks – Superior).

Description of Options

Options

U03
Version with CSA certification

With option **U03**, a drive version certified by the Canadian Standards Association (CSA) is supplied.

Note: Option **U03** includes option **M08** (mechanical door interlocks – Superior).

U02, U04 Combination
Version with CE and GOST certification

With the combination of **U02** and **U04**, a drive version with CE and GOST conformity is supplied.

Note: When options **U02** and **U04** are combined, options **L03** (EMC filter) and option **M12** (electrical door interlocks) are included.

U10
ProToPS

With option **U10**, the control system Process Tolerant Protection Strategy (ProToPS) is integrated – a ground-breaking process control system available exclusively from Siemens. Instead of tripping the drive and automatically shutting down the system due to a malfunction, ProToPS provides a hierarchical system of warnings in advance of potential drive system trip. This control strategy allows time to evaluate the situation and respond appropriately to avoid a system shutdown.

Note: Option **U10** includes the options **U11** (cell bypass).

Note: Contact the factory or your local Siemens sales representative for option **U10**.

U11
Cell bypass

With option **U11**, the drive system will automatically continue to operate uninterrupted if one or more cells has a fault. The continuous current rating is maintained with faulted cells but at a reduced voltage. This is a recommended option for critical processes. Faulted cells can then be replaced at a convenient planned maintenance window.

Note: Option **U11** is included by the option U10 (ProToPS).

V01 to V14
Motor Voltages

With the options **V01** to **V14**, the motor voltage can be selected. These options are mutually exclusive. Select one of them.

Option	Motor voltage
V01	2.3 kV
V02	2.4 kV
V03	3.0 kV
V04	3.3 kV
V05	4.0 kV
V06	4.16 kV
V07	4.8 kV
V08	5.0 kV
V09	5.5 kV
V10	6.0 kV
V11	6.3 kV
V12	6.6 kV
V13	6.9 kV
V14	7.2 kV

W31, W32
Design of Cooling

With options **W31** or **W32**, a heat exchanger is provided to cool the power components and transformer. They are mutually exclusive. For further details, please contact the factory or your local Siemens sales representative.

Option	Description
W31	Drive prepared for liquid-liquid heat exchanger
W32	Drive prepared for liquid-air heat exchanger

Note: The heat exchangers are not integral to the drive lineup and require outside installation by customer.

Note: One heat exchanger unit is required per drive system.

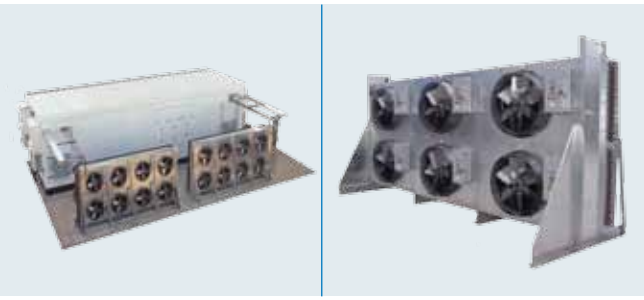
Example of liquid-liquid heat exchanger

Plate and Frame Heat Exchanger

Options

Note: For more information on Liquid-Liquid heat exchangers, please contact your local Siemens sales representative for any questions or inquiries

Example of liquid-air heat exchanger



Note: For more information on Liquid-Air heat exchangers, please contact your local Siemens sales representative for any questions or inquiries.

W71
Deionized water supplied by Siemens

With option **W71**, Siemens will provide the required amount of deionized water for the inner closed loop cooling system.

W72, W73
Coolant glycol

For further details, please contact the factory or your local Siemens sales representative.

Option	Description
W72	**Propylene glycol supplied by Siemens** With option W72, Siemens will provide the required amount of propylene glycol for the inner closed loop cooling system.
W73	**Ethylene glycol supplied by Siemens** With option W73, Siemens will provide the required amount of ethylene glycol for the inner closed loop cooling system.

Y05
Customer-specific nameplate

As standard the nameplate shows the rated data of the drive under nominal conditions.

If data on the nameplate should be adapted to special ambient conditions (temperature, altitude) or should reflect special load conditions (e.g. derating because of operation at low frequency), the option **Y05** must be selected.

Information to be supplied:
- Altitude
- Coolant temperature
- Rated voltage
- Rated current
- Rated power

Y09
Paint finish other than standard

As standard the drives are supplied with ANSI 61 paint finish. A special color must be specified in plain text when ordering.

Y10
Circuit diagrams with customer-specific description field

The circuit diagrams are given customer-specific headers. The data for the header must be specified in plain text (up to three lines of 45 characters per line).

Y37
Customer specified touchscreen

A customer specified touchscreen will be provided on the door of the drive. Option **Y37** includes option **N85** (Keypad located internal to cabinet).

For details please contact the factory or your local Siemens sales representative.

Y38
Customer specified equipment on right door

With option Y38, customer specified equipment will be mounted on the right door.

Notes

Overview

NXGII ToolSuite

The NXGII ToolSuite is a PC-based high-level Graphical User Interface (GUI) application that integrates various software tools used for NXGII based drives. ToolSuite, equipped with the Microsoft Windows Operating System, allows navigation through a drive's features by using a PC or by using a touch screen (instead of an operator panel) – allowing you to monitor and control that drive's functions quickly and easily. The NXGII Control and the PC running the NXGII ToolSuite software, interface with one another using Ethernet and TCP/IP protocol. ToolSuite contains the following tools: Drive Tool, Debug Tool, and SOP Utilities.

Configuration

- Multilevel password to limit access
  - Passwords same as used in drive
- Folders for each drive configuration category (i.e., VFD Menu system)
  - Icon colors to indicate default and modified parameter values
  - On screen parameter identifier (matches operator panel IDs for speed menus)
  - Parameter editing assisted by minimum/maximum limits and defaults
- Ability to upload logs, parameters, system program
- Ability to download system program and/or configuration data files

Graphing

- Adjustable time scale
- Predefined variable list to select variable to be graphed
- Graph up to 10 variables
- Individual variable offsets
- Individual variable scaling
- Customizable graphics – fonts, color, styles
- Freeze graphics
- Freeze graph on fault
- Freeze on selectable trigger
- Zoom graph
- Printable graphics
- Exportable graphics

Status

- Programmable display variables
- Pick list selectable variables, same as drive operator panel display list
- First 4 synchronized to operator panel display
- Fault and alarm indicators (traffic lights: red = fault, yellow = alarm, green = none)

Control (only if enabled by SOP)

- Manual start button
- Stop button
- Fault reset button

Drive Tool

Its purpose is to manage all of the drive features and provide the user with a user-friendly view of the drive.
The Drive Tool's main features include:

- Drive configuration
- Drive variable graphing
- Drive status (provides real time status of various parameters, measured values, and calculations)

Debug Tool

This application provides a remote graphical user interface for Siemens medium-voltage ROBICON Perfect Harmony NXGII series drives. With the Debug Tool, the user can examine drive variables using a PC in a simple and quick manner. The debug utility is intended for use during test, commissioning, and troubleshooting of the drive.

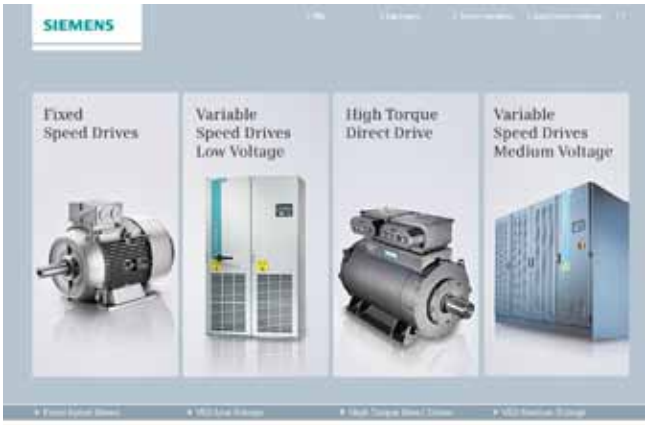
SOP Utilities

The System Operating Program (SOP) is the logic that maps the internal and external I/O into the functionality of the drive. In its simplest form, it just maps internal states to external points. In more complex forms, additional complex logic, in the form of Boolean logic, as well as timers, counters, and comparators, express the system functionality to the drive.

The SOP Utilities is a group of utilities under the ToolSuite umbrella program. It performs most of the functionality on the PC running the ToolSuite, but has serial communications capability for uploading and downloading the System Program directly to the drive via an RS232 interface between the drive and the PC. The purpose of the SOP Utilities Tool is to convert logic statements into a form of machine-recognizable code that is run under the built-in drive SOP interpreter.

Tools

SinaSave



Based on characteristic plant values, SinaSave calculates the possible cost-saving potential for the specific application. A payback time is obtained from the monthly overall saving of the application and the purchase and installation costs for the motor or frequency drive. This payback time is frequently just a few months.

Function
SinaSave is designed to select an energy-efficient motor for line operation or a frequency drive for variable-speed and therefore energy-saving operation.

For line operation, the tool can calculate the cost savings as well as the payback time for Siemens energy-saving motors, class IE2 or NEMA Premium using three comparison cases: In comparison to IE1 or EPAct motors, individually selected and known motors or in comparison to known motors when investigating a complete plant.

For drive operation, SinaSave takes into account all of the necessary plant or system-specific parameters as well as the values required for the process; these include, for example, the flow rate for pumps, the specific density of the medium being transported and the efficiency of the fluid flow machines of the complete plant. Additional basic data that the program requires includes the number of working days and work shifts as well as the pumping profile over a day and a year, which are decisive for the energy-saving impact.

Using the plant-specific data, the program selects the optimum drive system, calculates the price of a suitable frequency drive and determines the energy requirements of the variable-speed drive system when compared to all of the alternative concepts that could be possibly considered.

In addition to high-efficiency motors (IE2) SinaSave also includes low-voltage and medium-voltage frequency drives, which are predestined for pump and fan application.

Further, the motor side has been supplemented by a new feature that takes into consideration the mechanical system. High-torque motors have also been recently integrated. User-friendly functions such as an automatic update function, an up-to-date currency table and improved functions (e.g. sending pdfs by e-mail) round-off the functionality of this energy-saving tool.

Additional information
Additional information on services relating to energy-saving topics is provided on the Internet:
www.siemens.com/sinasave
www.siemens.com/energy-saving

Accessories

Cell lifter
The power cells of the ROBICON Perfect Harmony drives can be replaced as a unit. To replace, the entire power cell must be extracted from the drive and transported on a cell lifter.

Cell lifter data		WCIII
Carrying capacity	lb	500
	kg	226
Highest platform position	in	68
	mm	1727
Order number	6SR3950-0SM10-1AD0	

Mode of operation

Control features

The following table provides a summary of the performance offered by the ROBICON Perfect Harmony drives with NXGII control.

Overview of control features

Feature	Description
Output frequency	0 ... 300 Hz [1] ; above 167 Hz, current derating is required
Modulation	Multi-level PWM
Ride-through	• Medium-voltage ride-through: minimum 5 cycles • Control power ride-through with UPS: minimum 5 cycles
Spinning load	• Instantaneous mode: allows fast bypass • Frequency scan mode: performed after residual motor voltage has collapsed
Induction motor control	• V/Hz for parallel motors (VHz) • Open-loop vector control for induction motors (OLVC) • Closed-loop vector control for induction motors (CLVC)
Synchronous motor control	• Open-loop vector control for synchronous motors (OSMC) • Closed-loop vector control for synchronous motors (CSMC)
Emergency Stop category	Emergency stop category 0 is set as standard for an uncontrolled shutdown. The function includes voltage disconnection of the drive output by opening the circuit-breaker. Consequently the motor coasts down.
Energy saver	Single parameter driven (for induction motors only)
Braking [2]	• Inverse speed (max. braking torque is approx. 0.25 % at full speed and increases as speed is reduced) • Regenerative Braking [3] • Dynamic Braking [4]
Auto tuning	Available for induction motors as long as the drive rating is higher than 67 % of the motor
Advanced Cell Bypass (option U11)	250 ms downtime with redundant cells; without redundant cells, the downtime depends on the motor open circuit time constant
Synchronous transfer (option L29)	Closed synchronous transfer available for induction and synchronous motors [5]
Voltage minimum boost	Not implemented; as an alternate, automatic stator resistance compensation is available in OLVC/CLVC/OSMC/ CSMC control modes (also see description for flux attenuation shaping)
Flux attenuation shaping	Not implemented; a simple (single parameter function) implementation is available
Zero speed control	Not implemented

1) Although 0 Hz can be produced by the drive, torque production is limited.
2) Note: 4Q cells are qualified and released for braking (intermittent) regeneration applications. Please, contact the factory or your local Siemens sales representatives for more details.
3) For continuous power regeneration applications, please, contact the factory or your local Siemens sales representatives for more details.
4) For Dynamic Braking, please, contact the factory or your local Siemens sales representatives for more details.
5) Synchronous transfer applications with synchronous motors would require a PLC to manage the exciter control.

Mode of operation (continued)

Drive input protection

ROBICON Perfect Harmony utilizes software functions to detect abnormal conditions due to an internal drive failure and thus provides protection to the drive. Below you find a description of some routines that are implemented in NXGII control for drive protection.

Faults within the drive can be categorized into two types – "low impedance" (with high current) and "high impedance" (with low current) faults. A "low impedance" fault within the drive or the secondary side of the transformer would result in a significant reactive current on the primary side. The "one cycle protection" (or excessive input reactive current detection) is implemented to detect such types of faults. A "high impedance" fault within the drive would result in low current that is difficult to detect on the primary side of the transformer but will result in measurable losses that can be used to sense the condition. The "excessive drive losses protection" allows the detection of such faults.

The level of currents detected by these functions cannot be easily detected and may be insufficient to activate the main primary protection. Hence the fault signals issued by these routines should be used with suitable interlocking, via a relay output and/or serial communication, to disconnect medium-voltage from the drive input.

One cycle protection (or excessive input reactive current detection)

NXGII control utilizes the reactive component of the drive input current to determine whether a "low impedance" fault on the secondary side of the transformer has occurred. For example, a short-circuit in one of the secondary windings will result in poor power factor on the high-voltage side of the transformer. A software model of the transformer is used to predict the reactive component of primary current based on the known load. An alarm and trip are generated when the actual reactive current exceeds this prediction based on an inverse time curve. Further in formation on this curve and the time to trip is provided below. This event will normally cause the input disconnect device to open. The one cycle protection is defeated during the first 0.25 seconds after primary voltage is applied, to allow transformer saturation inrush to decay.

Excessive drive losses protection

The excessive drive losses protection uses drive losses to protect the drive against "high impedance" fault conditions. The drive losses are calculated as the difference between the measured input and output powers, and compared against reference losses. Once the threshold is exceeded, a fault is issued and the drive trips based on an inverse time curve. During the idle state if the drive losses exceeds the idle threshold by 1 to 2 % the control will issue a command to open the input breaker within 250 ms. Such a fast response will greatly reduce the adverse effect of a "high impedance" fault on the drive system.

Speed and torque control

Feature	V/Hz control	Open-loop vector control	Closed-loop vector control
Speed range (for 100% holding torque and 150% starting torque)	40:1	100:1	200:1
Torque regulation (% of rated)	n/a	± 2 %	± 2 %
Torque linearity (% of rated)	n/a	± 5 %	< ± 5 %
Torque response [1]	n/a	> 750 rad/s	> 750 rad/s
Speed regulation (% of rated)	Motor slip	± 0.5 % [2]	± 0.1 % [3]
Speed response [4]	20 rad/s	20 rad/s	> 20 rad/s [5]
Torque pulsation (% of rated) without over-modulation [6]	< 1.0 %	< 1.0 %	< 1.0 %
Torque pulsation (% of rated) with over-modulation [6]	< 3.5 %	< 3.5 %	< 3.5 %

Note: Applications that require lower than 1% speed operation under high load torque should use the CLVC mode. In such cases it is preferable to select a motor that has high full-load slip (> 1.0 %) and high breakdown torque.

1) Torque response values are valid for drive without an output filter. Tuning may be required to achieve these values.
2) Approx. 0.3 % speed error is typical. Worst-case speed error is equal to approximately 30 % of rated motor slip.
3) 0.1 % can be achieved with a 1024 PPR encoder. Speed accuracy depends on the encoder PPR.
4) Speed response numbers apply as long as torque limit is not reached.
5) Testing is required to determine exact value.
6) ROBICON Perfect Harmony drives when not operated in over-modulation, will have torque pulsation amplitudes of less than 1% as listed in the above table. For a drive operating in over-modulation the torque pulsation is higher at the 6th harmonic frequency (i.e. 6f component) which is introduced only in the speed range of 95 to 100 % of rated. Torque pulsations at all other frequencies are under 1 % of rated. Refer to section Output Voltage Characteristics (next page) for more information on the cell voltage and drive output voltage ratings that will operate with over-modulation.

Function

Output voltage characteristics

Output voltage

Quantity	Value
Distortion at rated voltage (as a % of rated output voltage)	without over-modulation: ≤ 2 % (for the first 20 harmonics) with over-modulation: ≤ 3 % 1) (for the first 20 harmonics)
Unbalance (as a % of rated output voltage)	≤ 1 %
dV/dt 2)	< 1000 V/µs for 750 V
Harmonic voltage factor (HVF) 3)	< 0.02

Harmonic voltage factor as a function of ranks with 750 V cells (WCIII)

Number of cells	Output voltage kV	HVF
9	4.16 4)	0.019
12	4.80	0.012
15	6.00	0.008
15	6.60	0.007
18	7.20	0.006
18	8.00	0.005

Output current

Quantity	Value
DC component (as a % of rated output current)	≤ 1 %
Distortion of THD 5) 6) (as a % of rated output current; when motor and drive ratings are equal and the motor leakage reactance is 16 % or higher)	without over-modulation ≤ 3 % with over-modulation ≤ 4.5 %

Output voltage characteristics

1) Only WCIII drives with a specific cell count and rated output voltage will operate in over-modulation in the 95-100% speed range. Higher output voltage and current harmonic components at 5th and 7th harmonic frequencies will exist as reflected in the THD and torque pulsation values.
2) Although output dV/dt values are high, the control ensures that only one cell switches at a particular instant. The magnitude of voltage steps \ applied to the motor are thus smaller than the rated voltage (and equal to the DC-bus voltage of a single cell), which limits the stress on the insulation of the first few turns (of the motor winding).
3) No motor derating is required when the inverter voltage waveform has a HVF value that is less than 0.03. HVF. All Perfect Harmony configurations (with more than 9 cells) meet this requirement.
4) The output current distortion limit of 3 % is valid for drives with # of cells ≥ 9 and no over-modulation. As the number of cells increases, the current distortion decreases to below 2 % for 18 cell drives with a typical motor.
5) The output current distortion limit of 3 % is valid for drives with number of cells ≥ 9 and no over-modulation. As the number of cells increases, the current distortion decreases to below 2 % for 18 cell drives with a typical motor.
6) Most motors have a leakage reactance that is greater than 16 %. Output current distortion is inversely proportional to motor leakage reactance, i.e. as motor leakage reactance decreases, output current distortion increases.

Function (continued)

With all cells operating
The maximum output voltage of the drive in terms of the number of ranks and the secondary-side cell voltage is given as:

$$V_{out} = 1.78 \times N \times \frac{V_{cell\_rating} \times Tap\_setting \times V_{input}}{V_{input\_rated}}$$

N = number of ranks (Number of Cells / 3)
V_{cell_rating} = 750 V
V_{input} = actual input line voltage
$V_{input_}$rated = rated drive input voltage
Tap_Setting = 1.00 (for 0 % tap), 0.95 (for +5 % tap) or 1.05 (for –5 % tap)
Output voltage capability must be calculated based on worst-case line voltage (minimum value).

With Over-Modulation (for 750 V cells only)

When over-modulation is used in the control for additional voltage capability, the maximum output voltage increases by 5 % and is given as:

$$V_{out} = 1.05 \times 1.78 \times N \times \frac{V_{cell\_rating} \times Tap\_setting \times V_{input}}{V_{input\_rated}}$$

Note
The use of over-modulation is discouraged. However, in exceptional cases over-modulation may be utilized but only after consulting the factory or your local Siemens sales representative.

Available Drive Power as a Function of Input Voltage

Input under-voltage rollback
In the event that the input voltage falls below 90 %, the attached description provides details of drive limitations.

When the input line voltage drops below 90 % of its rated value, the drive limits the amount of power (and hence the torque) that can be delivered to the load. The maximum allowable drive power as a function of line voltage is shown in the figure below. At 66 % input voltage, the maximum drive power is limited to 50 % and is quickly reduced to a slightly negative value (regen limit) at 65 %. This limit forces the drive to absorb power from the motor and maintain the (power cell) DC-bus voltages in case the input voltage recovers during MV ride-through. The limit is implemented as an inverse function of speed in order to maintain constant power flow to the (cell) DC-bus.

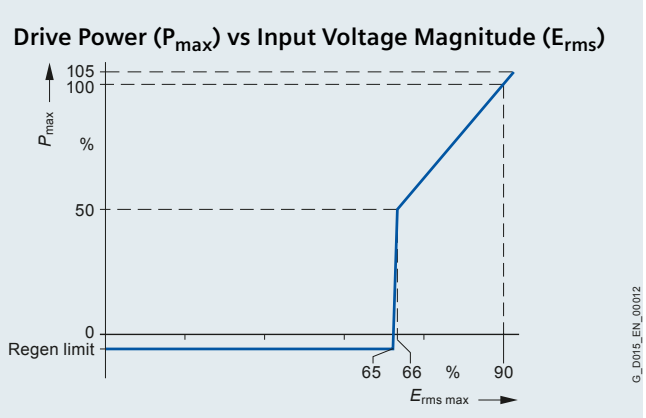


Figure 5.1 Drive power (P_{max}) as a function of input voltage magnitude (E_{rms})

Once the input voltage falls below 65 %, the drive reduces output power to a slightly negative value and maintains synchronism with the motor for a period greater than five cycles. Once input voltage is restored, the drive begins by magnetizing the motor and then continues with torque production. There is no delay in drive restart.

If input voltage is not restored after five cycles the drive maintains synchronism with the motor as long as the power cells can operate without input power or as long as there is motor voltage (to synchronize to). Once operation of any power cell stops or if motor voltage decays significantly, the drive trips on a loss of input medium-voltage.

Configuration

Overview

The liquid-cooled ROBICON Perfect Harmony drive has a common control system namely NXGII. This control system offers digital and analog input and output capabilities through the use of the I/O breakout board and the I/O WAGO modules.

I/O breakout board

This board consists of 20 digital inputs, 16 digital outputs, 3 analog inputs and 2 analog outputs. The following table shows the main characteristics of the I/O breakout board.

I/O breakout board characteristics

Signal type	Quantity	Configuration
Digital inputs	20	24 V DC or 120 V AC
Digital outputs	16	Dry form "C" contacts, rated 250 V AC at 1 A or 30 V DC at 1 A
Analog inputs	3 [1)]	0/4 ... 20 mA or 0 ... 10 V DC
Analog outputs	2	4 ... 20 mA

I/O WAGO modules

WAGO™ is an off the shelf solution for interfacing digital and analog I/O to the NXGII controller via Modbus protocol. The table below shows some of the WAGO modules used in the WCIII series drive.

WAGO modules characteristics

Signal type	Channels	Configuration
Digital inputs	1 ... 2 1 ... 4	120 V AC 24 V DC
Digital outputs	1 ... 2	relay output, rated 250 V AC at 1 A or 40 V DC at 1 A
Analog inputs	1 ... 2	4 ... 20 mA 0 ... 10 V DC
Analog outputs	1 ... 2	4 ... 20 mA

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[1)] Only two out of the three analog inputs can be 0 to 10 V; one analog will always be a 4 to 20 mA.

Keypad

The ROBICON Perfect Harmony drive series contains a user-friendly operator panel. This operator panel is located on the front of the control cabinet for operation, monitoring and commissioning of the drive. The operator panel is illustrated in figure below.

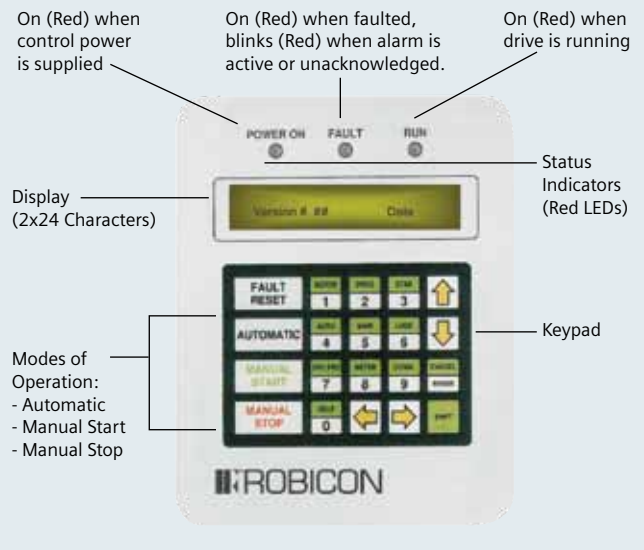


Figure 5.2 The operator panel of the ROBICON Perfect Harmony drive series

The operator panel offers the following features and characteristics:

- LCD display (2 x 24 characters).
- LEDs for displaying operational status.
- Numerical keypad to enter set points or parameter values
- Automatic key set the drive in automatic mode
- Manual start key enables the operator to control the drive from the operator panel
- Manual stop key to shut down the drive in a controlled manner
- Security access code for safe operation

One of the most important functions of the operator panel is parameter monitoring. Below you find a reduced list of parameters that can be monitored by using the operator panel:

The following are a few of the list of parameters that can be monitored on the operator panel:

Input voltage [V]	Output power [kW]
Input voltage harmonics (one at a time)	Output energy [kWh]
Input current [A]	Output current [A]
Input current harmonics (one at a time)	Output voltage [V]
Input power factor	VFD efficiency
Input power [kW]	Motor torque [Nm]
Input reactive power [kVAR]	Motor speed [RPM]
Input energy [kWh]	Motor slip [%]
Input phase sequence	Drive output frequency [Hz]
Loss of phase	Magnetizing current [A]
Low-voltage	Torque current [A]
Transformer overload	Motor flux [Wb]

Overview

The standard scope of delivery of the ROBICON Perfect Harmony comprises:

Standard units

The basic unit of each ROBICON Perfect Harmony product-line consists of the following:
- Input cabinet
- Transformer cabinet
- Cell cabinet
- Control cabinet
- Output cabinet
- Coolant cabinet [1)]

Items not included in the standard scope of delivery

The following items are not included in the standard scope of delivery:
- Cables, lugs and glands
- Isolators, contactors or circuit-breakers (optionally available)
- Make-proof grounding switch (optionally available)
- Motors
- Cable runways or cable ducts
- Piping for cooling cabinets
- Harmonic filters
- Harmonic analysis
- Torsional analysis
- Erection work
- Commissioning
- Acceptance test with experts for the complete drive system

1) The coolant cabinet is delivered without deionized water. The heat exchanger is delivered and located separately. The necessary pipes and connection pieces (to converter and raw-water supply on the plant side) are not included in the scope of delivery.

Dimension Drawings

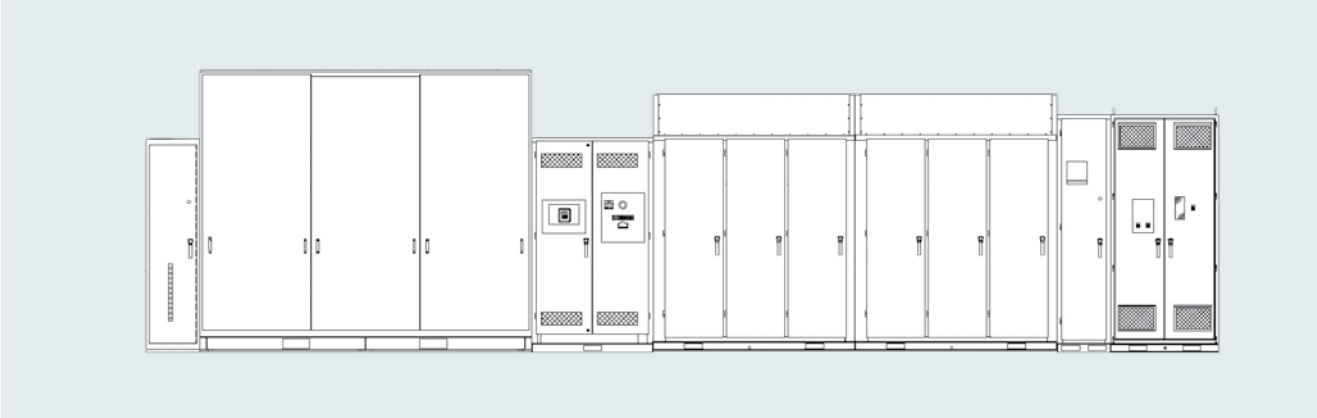


Figure 5.3 WCIII Standard Unit System Dimensions

Motor Voltage	Shaft Output		WCIII System Cabinet					
			Cabinet width		Cabinet height		Cabinet depth	
kV	hp	kW	mm	in	mm	in	mm	in
3.3	4000...6500	2893...4847	9400	370	2896	114	1680	66
	7000...8500	5220...6338	9600	378	2920	115	1680	66
4.0/4.16	4000...6500	2893...4847	9400	370	2896	114	1680	66
	7000...10000	5220...7457	9600	378	2920	115	1680	66
4.6 / 4.8	4000...4500	2893...3356	10110	398	2896	114	1680	66
	5000...9500	3729...7084	10310	406	2920	115	1680	66
	10000...12000	7457...8948	10470	412	2920	115	1780	70
6.0	4000...4500	2893...3356	10800	425	2896	114	1680	66
	5000...9500	3729...7084	11100	433	2920	115	1680	66
	10000...15000	7457...11185	11150	439	2920	115	1780	70
6.6	4000...4500	2893...3356	10800	425	2896	114	1680	66
	5000...9500	3729...7084	11100	433	2920	115	1680	66
	10000...17000	7457...12677	11150	439	2920	115	1780	70
6.9/7.2	4000...9500	2893...7084	11890	468	2920	115	1680	66
	10000...13000	7457...9694	12040	474	2920	115	1780	70
	14000...18000	10440...13423	12140	478	3180	125	1930	76

Notes

Services and Documentation

Overview

The priority of Siemens training programs is to help customers maintain and maximize the efficiency of their Siemens equipment. The greater the knowledge of the system and its functions, the higher the efficiency the operator will obtain from the equipment.

The combination of our knowledge and field experience coupled with continuous research and development has made our training program one of a kind in the industry. The excellence of our staff and our numerous world-wide training locations are proof of our commitment to product education, maintenance and employee safety issues.

By combining modern teaching methods with the latest technology, we offer the best there is in training. Siemens tailors its training programs to meet the individual customer's product and application needs. This method of teaching avoids the "cookie-cutter" approach that tends to limit and generalize. We focus on you, your process and your equipment. And we train all associated personnel including operators, maintenance personnel, electrical technicians and electrical engineers.

Benefits

- Higher customer comfort level with Siemens equipment
  - By means of theoretical explanation and hands-on experience
- Safety
  - By learning best practices and protective equipment
- Reduce costly downtime
  - By being able to address issues in a timely fashion
  - By identifying spare parts needed
- Reduce repairs
  - By addressing issues in advance through maintenance
- Minimize Siemens field service calls

More information

Course descriptions

ROBICON Perfect Harmony Operator Class (4 hours)
This training program is designed to cover the key aspects for drive operators. Included in this session will be a brief introduction to ROBICON Perfect Harmony drives series, the drive topology and layout, safety guidelines, key parameters, operating the drive, reading faults/alarms.

Contents:
- Introduction to the ROBICON Perfect Harmony series of drives
- ROBICON Perfect Harmony specifications
- Safety on medium-voltage drives
- ROBICON Perfect Harmony topology
- Drive hardware identification
- General operation of the ROBICON Perfect Harmony drive – hands on
- Workshops – at the equipment
  - Safety
  - Operation
  - Fault/alarm logger
  - Acceleration/deceleration
  - Minimum speed/maximum speed

ROBICON Perfect Harmony Drive Orientation Class (8 hours)
This training program is designed to cover the key aspects for drive operators. Included in this session will be a general overview of the ROBICON Perfect Harmony drive, theory of operation, hardware identification, operation of the drive, alarms and faults, and spare parts. The interface of the software to the drive is demonstrational only.

Contents:
- Introduction to the ROBICON Perfect Harmony series of drives
- ROBICON Perfect Harmony specifications
- Safety on medium-voltage drives
- ROBICON Perfect Harmony topology
- Drive hardware identification
- Control boards, basic operation
- Customer drawings review
- General operation of the ROBICON Perfect Harmony drive – hands on
- Demonstration on how to use HyperTerminal to upload files – hands on
  - Fault log
  - Historic log
  - Event log
  - Parameter log
- ToolSuite/debug demonstration only – hands on

ROBICON Perfect Harmony Maintenance Class (2 days) [1)]
This training program is designed to cover the key aspects for an overview for maintenance personnel. This program covers each aspect of the drive in detail so maintenance personnel will obtain an understanding and feel comfortable with the drive. Included in this session will be the drive layout, safety guidelines, lockout tag out, key parameters, operating the drive, obtaining faults/alarms, hardware identification and operation, review of equipment drawings. In this session attendees perform workshops to obtain a high comfort level working on the drive. The training session covers basic troubleshooting. The interface of the software to the drive is demonstrational only.

Contents:
- Introduction to the ROBICON Perfect Harmony series of drives
- ROBICON Perfect Harmony specifications

[1)] Please, contact your Service Sale Representative for more information.

More Information (continued)

- Safety on medium-voltage drives
- ROBICON Perfect Harmony topology
- Drive hardware identification
- Control boards, basic operation, replacement and spare parts
- Customer drawings review
- General operation of the ROBICON Perfect Harmony drive – hands on
- Demonstration on how to use HyperTerminal to upload files– hands on
  - Fault log
  - Historic log
  - Event log
  - Parameter log
- ToolSuite/debug demonstration only – hands on
- Preventive maintenance
- Supplied spare parts list (provided on customer request only)

ROBICON Perfect Harmony Advance Maintenance Class (4 days)
This advanced training program is designed to cover the key aspects for maintenance personnel. This program covers each aspect of the drive in detail, so maintenance personnel will be able to troubleshoot the drive in a safe format.

Included in this session will be the drive layout, safety guide-lines, lockout/tag out, parameters, operating the drive, obtaining faults/alarms, hardware identification and operation. Overview of the System Operational Program (SOP), which is a group of programmable logic functions that define features and capabilities of the drive. Complete review of the equipment drawings. Software will be provided and loaded on the customer's computer for interface to the controls. This training class is designed as 50 % of the time theoretical and 50 % hands on.

Contents:
- Introduction to the ROBICON Perfect Harmony series of drives
- ROBICON Perfect Harmony specifications
- Fundamental drive terminology
- Motor theory
- Safety on medium-voltage drives
- Power devices
- ROBICON Perfect Harmony topology
- Drive hardware identification
- Control boards, basic operation, replacement and spare parts
- Customer drawings review
- General operation of the ROBICON Perfect Harmony drive – hands on
- Presentation of Siemens software package – hands on
  - Installation of the software on customer laptops
  - Instructions on the program and its operation
- Utilization of ToolSuite/debug – hands on
  - ToolSuite software installation, setup and interface to the drive
- Preventive maintenance, troubleshooting, installation and set-up
- Bypass operation
- Workshops – hands on
  - Hardware identification
  - Pull power cell
  - Operator panel operation – changing parameters, viewing logs
  - Drive operation – manual/automatic control
  - Laptop interface to the drive
  - Waveforms on the control boards via oscilloscope

Availability

For more information on ROBICON Perfect Harmony training courses, please contact the following phone number:
+1 800 333 7421

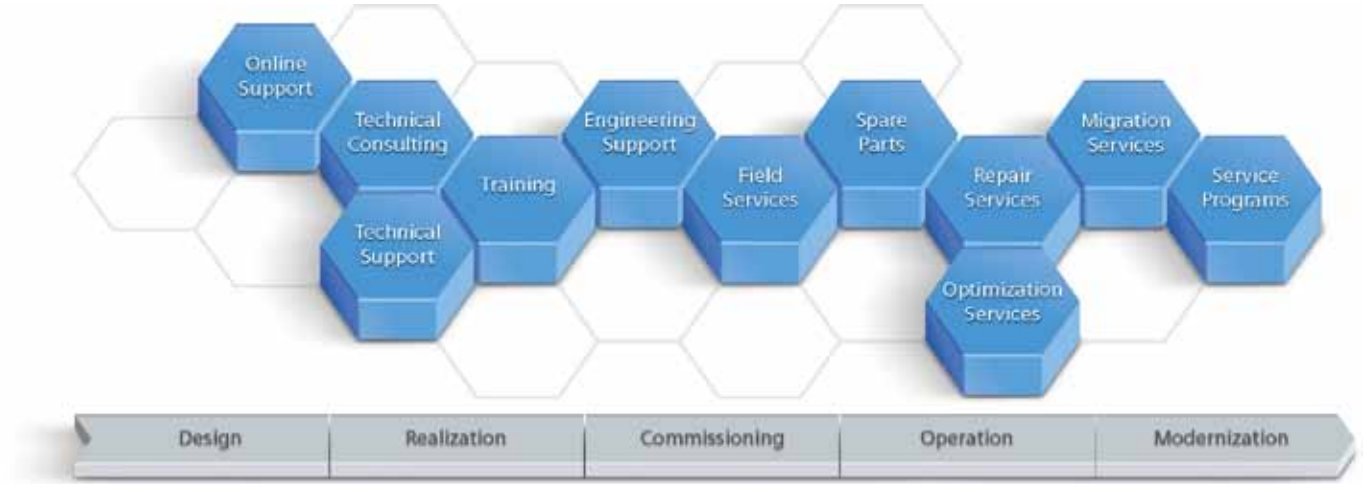
Documentation

The O&M manual will be send to the customer following the shipment of the ROBICON Perfect Harmony drive.
This manual includes the following standard sections:

- Equipment list template
- Supplied spare parts list
- Maintenance instructions
- Field service information
- Storage requirements
- Recommended spare parts
- Warranty information
- Product user manuals
- System operating program (SOP)
- Drawings of the drives (outline and wiring)

The documentation is in English. Further languages can be ordered if required (see description of options).

Services and Documentation



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www.siemens.com/automation/partner

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Support during project engineering and development with services fine-tuned to your requirements, from configuration through to implementation of an automation project.

Repairs

Downtimes cause problems in the plant as well as unnecessary costs. We can help you to reduce both to a minimum – with our worldwide repair facilities.

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Our Field Service offers you services for commissioning and maintenance – to ensure that your machines and plants are always available.

Optimization

During the service life of machines and plants, there is often a great potential for increasing productivity or reducing costs. To help you achieve this potential, we are offering a complete range of optimization services.

Spare Parts

In every sector worldwide, plants and systems are required to operate with constantly increasing reliability. We will provide you with the support you need to prevent a standstill from occurring in the first place: with a worldwide network and optimum logistics chains.

Upgrades and Retrofits

You can also rely on our support when it comes to modernization – with comprehensive services from the planning phase all the way to commissioning.

Notes

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Standard terms and conditions of sales and delivery

Conditions of sale and delivery

1. Applicable Terms. These terms govern the sale of Products by Siemens. Whether these terms are included in an offer or an acceptance by Siemens, such offer or acceptance is conditioned on Buyer's assent to these terms. Any additional, different or conflicting terms contained in Buyer's request for proposal, specifications, purchase order or any other written or oral communication from Buyer shall not be binding in any way on Siemens. Siemens failure to object to any such additional, different or conflicting terms shall not operate as a waiver of these terms.

2. Pricing and Payment. The prices shall be: (a.) as stated in Siemens' proposal, or if none are stated, (b.) Siemens' standard prices in effect at the time of release for shipment. In the event of a price increase or decrease, the price of Products on order shall be adjusted to reflect such increase or decrease. This does not apply to a shipment held by request of Buyer. Products already shipped are not subject to price increase or decrease. Discounts, if any, are as specified on the latest discount sheets issued from time to time. Cash discounts are not applicable to notes or trade acceptances, to prepaid transportation charges when added to Siemens' invoices or to discountable items if there are undisputed past due items on the account. Cash discounts shall only be allowed on that portion of the invoice paid within the normal discount period.
   (a) Payment – Unless otherwise stated, all payments shall be net 30 days from invoice date payable in United States Dollars.
   (b) Credit Approval – All orders are subject to credit approval by Siemens. The amount of credit or terms of payment may be changed or credit withdrawn by Siemens at any time for any reason without advance notice. Siemens may, in its discretion, withhold further manufacture or shipment; require immediate cash payments for past and future shipments; or require other security satisfactory to Siemens before further manufacture or shipment is made; and may, if shipment has been made, recover the Products from the carrier, pending receipt of such assurances.
   (c) Installment Shipment – If these terms require or authorize delivery of Products in separate shipments to be separately accepted by Buyer. Buyer may only refuse such portion of such shipment that fails to comply with the requirements of these terms. Buyer may not refuse to receive any lot or portion of hereunder for failure of any other lot or portion of a lot to be delivered or to comply with these terms, unless such right of refusal is expressly provided for on the face hereof. Buyer shall pay for each lot in accordance with the terms hereof. Payment shall be made for the Products without regard to whether Buyer has made or may make any inspection of the Products. Products held for Buyer are at Buyer's sole risk and expense.
   (d) Taxes, Shipping, Packing, Handling – Except to the extent expressly stated in these terms, Siemens' prices do not include any freight, storage, insurance, taxes, excises, fees, duties or other government charges related to the Product, and Buyer shall pay such amounts or reimburse Siemens for any amounts Siemens pays. If Buyer claims a tax or other exemption or direct payment permit, it shall provide Siemens with a valid exemption certificate or permit and indemnify, defend and hold Siemens harmless from any taxes, costs and penalties arising out of same. Siemens' prices include the costs of its standard domestic packing only. Any deviation from this standard packing (domestic or export), including U.S. Government sealed packing, shall result in extra charges. To determine such extra charges, consult Siemens' sales offices. Any and all increases, changes, adjustments or surcharges (including, without limitation, fuel surcharges) which may be in connection with the freight charges, rates or classification included as part of these terms, shall be for the Buyer's account. Orders of less than $400 are subject to a $25 handling fee.
   (e) Finance Charge – Buyer agrees to pay FINANCE CHARGES on the unpaid balance of all overdue invoices, less any applicable payments and credits, from the date each invoice is due and payable at an ANNUAL PERCENTAGE RATE of EIGHTEEN PERCENT (18%), or the highest applicable and lawful rate on such unpaid balance, whichever is lower.
   (f) Disputed Invoice – In the event Buyer disputes any portion or all of an invoice, it shall notify Siemens in writing of the amount in dispute and the reason for its disagreement within 21 days of receipt of the invoice. The undisputed portion shall be paid when due, and FINANCE CHARGE on any unpaid portion shall accrue, from the date due until the date of payment, to the extent that such amounts are finally determined to be payable to Siemens.
   (g) Collection. Upon Buyer's default of these terms, Siemens may, in addition to any other rights or remedies at contract or law, subject to any cure right of Buyer, declare the entire balance of Buyer's account immediately due and payable or foreclose any security interest in Products delivered. If any unpaid balance is referred for collection, Buyer agrees to pay Siemens, to the extent permitted by law, reasonable attorney fees in addition to all damages otherwise available, whether or not litigation is commenced or prosecuted to final judgment, plus any court costs or expenses incurred by Siemens, and any FINANCE CHARGES accrued on any unpaid balance owed by Buyer.

Conditions of sale and delivery (continued)

3. Delivery; Title; Risk of Loss. Product shall be delivered F.O.B. Siemens point of shipment with title to the Product and risk of loss or damage for the Product passing to Buyer at that point. Buyer shall be responsible for all transportation, insurance and related expenses including any associated taxes, duties or documentation. Siemens may make partial shipments. Shipping dates are approximate only and Siemens shall not be liable for any loss or expense (consequential or otherwise) incurred by Buyer or Buyer's customers if Siemens fails to meet the specified delivery schedule. A 5% handling charge will be added to the price for all Product furnished from a local branch.

4. Deferment and Cancellation. Buyer shall have no deferment rights and Buyer shall be liable for cancellation charges, which shall include without limitation
   (a) payment of the full product price for any finished Product or works in progress;
   (b) payment for raw materials ordered pursuant to a firm purchase order; and
   (c) such other direct costs incurred by Siemens as a result of such cancellation.

5. Force Majeure / Delays. If Siemens suffers delay in performance due to any cause beyond its reasonable control, including without limitation acts of God, strikes, labor shortage or disturbance, fire, accident, war or civil disturbance, delays of carriers, failure of normal sources of supply, or acts of government, the time of performance shall be extended a period of time equal to the period of the delay and its consequences. Siemens will give to Buyer notice within a reasonable time after Siemens becomes aware of any such delay.

6. Buyer's Requirements. Timely performance by Siemens is contingent upon Buyer's supplying to Siemens all required technical information and data, including drawing approvals, and all required commercial documentation.

7. Limited Warranty.
   (a) Limited Product Warranty Statements. For each Product purchased from Siemens or an authorized reseller, Siemens makes the following limited warranties: (i) the Product is free from defects in material and workmanship, (ii) the Product materially conforms to Siemens' specifications that are attached to, or expressly incorporated by reference into, these terms, and (iii) at the time of delivery, Siemens has title to the Product free and clear of liens and encumbrances (collectively, the "Limited Warranties"). Warranties with respect to software which may be furnished by Seller as part of the Product, if any, are expressly set forth elsewhere in these terms. The Limited Warranties set forth herein do not apply to any software furnished by Siemens. If software is furnished by Siemens, then the attached Software License/Warranty Addendum shall apply.
   (b) Conditions to the Limited Warranties. The Limited Warranties are conditioned on (i) Buyer storing, installing, operating and maintaining the Product in accordance with Siemens' instructions, (ii) no repairs, modifications or alterations being made to the Product other than by Siemens or its authorized representatives, (iii) using the Product within any conditions or in compliance with any parameters set forth in specifications that are attached to, or expressly incorporated by reference into, these terms, (iv) Buyer discontinuing use of the Product after it has, or should have had, knowledge of any defect in the Product, (v) Buyer providing prompt written notice of any warranty claims within the warranty period described below, (vi) at Siemens' discretion, Buyer either removing and shipping the Product or non-conforming part thereof to Siemens, at Buyer's expense, or Buyer granting Siemens access to the Products at all reasonable times and locations to assess the warranty claims, and (vii) Buyer not being in default of any payment obligation to Siemens under these terms.
   (c) Exclusions from Limited Warranty Coverage. The Limited Warranties specifically exclude any equipment comprising part of the Product that is not manufactured by Siemens or not bearing its nameplate. To the extent permitted, Siemens herby assigns any warranties made to Siemens for such equipment. Siemens shall have no liability to Buyer under any legal theory for such equipment or any related assignment of warranties. Additionally, any Product that is described as being experimental, developmental, prototype, or pilot is specifically excluded from the Limited Warranties and is provided to Buyer "as is" with no warranties of any kind. Also excluded from the Limited Warranties are normal wear and tear items including any expendable items that comprise part of the Product, such as fuses and light bulbs and lamps.
   (d) Limited Warranty Period. Buyer shall have 12 months from initial operation of the Product or 18 months from shipment, whichever occurs first, to provide Siemens with prompt, written notice of any claims of breach of the Limited Warranties. Continued use or possession of the Product after expiration of the warranty period shall be conclusive evidence that the Limited Warranties have been fulfilled to the full satisfaction of Buyer, unless Buyer has previously provided Siemens with notice of a breach of the Limited Warranties.

Standard terms and conditions of sales and delivery

Conditions of sale and delivery (continued)

(e) Remedies for Breach of Limited Warranty. Buyer's sole and exclusive remedies for any breach of the Limited Warranties are limited to Siemens' choice of repair or replacement of the Product, or non-conforming parts thereof, or refund of all or part of the purchase price. The warranty on repaired or replaced parts of the Product shall be limited to the remainder of the original warranty period. Unless otherwise agreed to in writing by Siemens, (i) Buyer shall be responsible for any labor required to gain access to the Product so that Siemens can assess the available remedies and (ii) Buyer shall be responsible for all costs of installation of repaired or replaced Products. All exchanged Products replaced under this Limited Warranty will become the property of Siemens.

(f) Transferability. The Limited Warranties shall be transferable during the warranty period to the initial end-user of the Product.

THE LIMITED WARRANTIES SET FORTH IN THIS SECTION ARE SIEMENS' SOLE AND EXCLUSIVE WARRANTIES AND ARE SUBJECT TO THE LIMITS OF LIABILITY SET FORTH IN SECTION 8 BELOW. SIEMENS MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, COURSE OF DEALING AND USAGE OF TRADE.

8. LIMITATION OF LIABILITY. NEITHER SIEMENS, NOR ITS SUPPLIERS, SHALL BE LIABLE, WHETHER IN CONTRACT, WARRANTY, FAILURE OF A REMEDY TO ACHIEVE ITS INTENDED OR ESSENTIAL PURPOSES, TORT (INCLUDING NEGLIGENCE), STRICT LIABILITY, INDEMNITY OR ANY OTHER LEGAL THEORY, FOR LOSS OF USE, REVENUE, SAVINGS OR PROFIT, OR FOR COSTS OF CAPITAL OR OF SUBSTITUTE USE OR PERFORMANCE, OR FOR INDIRECT, SPECIAL, LIQUIDATED, PUNITIVE, EXEMPLARY, COLLATERAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, OR FOR ANY OTHER LOSS OR COST OF A SIMILAR TYPE, OR FOR CLAIMS BY BUYER FOR DAMAGES OF BUYER'S CUSTOMERS. SIEMENS' MAXIMUM LIABILITY UNDER THIS CONTRACT SHALL BE THE ACTUAL PURCHASE PRICE RECEIVED BY SIEMENS FOR THE PRODUCT AT ISSUE OR ONE MILLION DOLLARS, WHICHEVER IS LESS. BUYER AGREES THAT THE EXCLUSIONS AND LIMITATIONS SET FORTH IN THIS ARTICLE ARE SEPARATE AND INDEPENDENT FROM ANY REMEDIES WHICH BUYER MAY HAVE HEREUNDER AND SHALL BE GIVEN FULL FORCE AND EFFECT WHETHER OR NOT ANY OR ALL SUCH REMEDIES SHALL BE DEEMED TO HAVE FAILED OF THEIR ESSENTIAL PURPOSE. THESE LIMITATIONS OF LIABILITY ARE EFFECTIVE EVEN IF SIEMENS HAS BEEN ADVISED BY THE BUYER OF THE POSSIBILITY OF SUCH DAMAGES.

9. Patent and Copyright Infringement. Siemens will, at its own expense, defend or at its option settle any suit or proceeding brought against Buyer in so far as it is based on an allegation that any Product (including parts thereof), or use thereof for its intended purpose, constitutes an infringement of any United States patent or copyright, if Siemens is promptly provided notice and given authority, information, and assistance in a timely manner for the defense of said suit or proceeding. Siemens will pay the damages and costs awarded in any suit or proceeding so defended. Siemens will not be responsible for any settlement of such suit or proceeding made without its prior written consent. In case the Product, or any part thereof, as a result of any suit or proceeding so defended is held to constitute infringement or its use by Buyer is enjoined, Siemens will, at its option and its own expense, either: (a) procure for Buyer the right to continue using said Product; b) replace it with substantially equivalent non-infringing Product; or (c) modify the Product so it becomes non-infringing.

Siemens will have no duty or obligation to Buyer under this Article to the extent that the Product is (a) supplied according to Buyer's design or instructions wherein compliance therewith has caused Siemens to deviate from its normal course of performance, (b) modified by Buyer or its contractors after delivery, (c) combined by Buyer or its contractors with devices, methods, systems or processes not furnished hereunder and by reason of said design, instruction, modification, or combination a suit is brought against Buyer. In addition, if by reason of such design, instruction, modification or combination, a suit or proceeding is brought against Siemens, Buyer shall protect Siemens in the same manner and to the same extent that Siemens has agreed to protect Buyer under the provisions of the Section above.

THIS ARTICLE IS AN EXCLUSIVE STATEMENT OF ALL THE DUTIES OF THE PARTIES RELATING TO PATENTS AND COPYRIGHTS, AND DIRECT OR CONTRIBUTORY PATENT OR COPYRIGHT AND OF ALL THE REMEDIES OF BUYER RELATING TO ANY CLAIMS, SUITS, OR PROCEEDINGS INVOLVING PATENTS AND COPYRIGHTS.

10. Compliance with Laws. Buyer agrees to comply with all applicable laws and regulations relating to the purchase, resale, exportation, transfer, assignment, disposal or use of the goods.

11. Changes in Work. Siemens shall not implement any changes in the scope of work unless Buyer and Siemens agree in writing to the details of the change and any

Conditions of sale and delivery (continued)

resulting price, schedule or other contractual modifications. Any change to any law, rule, regulation, order, code, standard or requirement which requires any change hereunder shall entitle Siemens to an equitable adjustment in the prices and any time of performance.

12. Non-waiver of Default. Each shipment made hereunder shall be considered a separate transaction. In the event of any default by Buyer, Siemens may decline to make further shipments. If Siemens elects to continue to make shipments, Siemens' actions shall not constitute a waiver of any default by Buyer or in any way affect Siemens' legal remedies for any such default. Any waiver of Siemens to require strict compliance with the provisions of this contract shall be in writing and any failure of Siemens to require such strict compliance shall not be deemed a waiver of Siemens' right to insist upon strict compliance thereafter.

13 Final Written Agreement; Modification of Terms. These terms, together with any quotation, purchase order or acknowledgement issued or signed by Siemens, comprise the complete and exclusive agreement between the parties (the .Agreement.) and supersede any terms contained in Buyer's documents, unless separately signed by Siemens. These terms may only be modified by a written instrument signed by authorized representatives of both parties.

14. Assignment. Neither party may assign the Agreement, in whole or in part, nor any rights or obligations hereunder without the prior written consent of the other; provided however that Siemens may assign its rights and obligations under these terms to its affiliates and Siemens may grant a security interest in the Agreement and/or assign proceeds of the Agreement without Buyer's consent.

15. Applicable Law and Jurisdiction. These terms is governed and construed in accordance with the laws of the State of Delaware, without regard to its conflict of laws principles. The application of the United Nations Convention on Contracts for the International Sale of Goods is excluded. BUYER WAIVES ALL RIGHTS TO A JURY TRIAL IN ANY ACTION OR PROCEEDING RELATED IN ANY WAY TO THESE TERMS.

16. Severability. If any provision of these terms are held to be invalid, illegal or unenforceable, the validity, legality and enforceability of the remaining provisions will not in any way be affected or impaired, and such provision will be deemed to be restated to reflect the original intentions of the parties as nearly as possible in accordance with applicable law.

17. Export Compliance. Buyer acknowledges that Siemens is required to comply with applicable export laws and regulations relating to the sale, exportation, transfer, assignment, disposal, and usage of the Products provided under the Contract, including any export license requirements. Buyer agrees that such Products shall not at any time directly or indirectly be used, exported, sold, transferred, assigned or otherwise disposed of in a manner which will result in non-compliance with such applicable export laws and regulations. It shall be a condition of the continuing performance by Siemens of its obligations hereunder that compliance with such export laws and regulations be maintained at all times. BUYER AGREES TO INDEMNIFY AND HOLD SIEMENS HARMLESS FROM ANY AND ALL COSTS, LIABILITIES, PENALTIES, SANCTIONS AND FINES RELATED TO NON-COMPLIANCE WITH APPLICABLE EXPORT LAWS AND REGULATIONS.

PH/CSD/En March 01, 2010

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For Further Information

Siemens Drive Technologies:
www.automation.siemens.com/mcms/drives/en

Siemens drives family:
www.sea.siemens.com/us/products/drives

Local partners worldwide:
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