



Low voltage AC drives

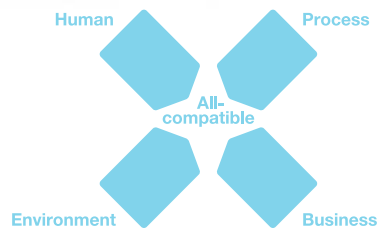
ABB industrial drives ACS880, drive modules 1.5 to 2200 kW Catalog

What does all-compatible mean for you?

Being all-compatible means that drive choice should add value to your business. Drives should meet the unique demands of your processes, help you save energy and reduce operating costs. Also, all-compatible means that our drives are easy to select, use and maintain. These are the cornerstones making our industrial drive series the all-compatible choice.

Contents

3	The all-compatible ACS880 series drives
4	Simplifying your world without limiting your possibilities
5	Drive modules, ACS880
6	Human all-compatible
7	Process all-compatible
8	Environment all-compatible
9	Business all-compatible
10	How to select a drive
11	Technical data
12	Single drive modules, ACS880-04
13	High power single drive module packages, ACS880-04
14	Ratings, types and voltages - ACS880-04
15	Multidrive modules, ACS880-X04
16	Multidrive modules, ACS880-X04
17	Ratings, types and voltages - Inverter modules (INU), ACS880-104
18	Ratings, types and voltages - IGBT supply units (ISU), ACS880-204
18	Ratings, types and voltages - Diode supply modules (DSU), ACS880-304
19	Standard interface and extensions for comprehensive connectivity
20	Standard software for scalable control and functionality
21	Ready made programs for application control
22	Intuitive human-machine interface
23	PC tool for easy startup and maintenance
24	Integrated safety simplifies configuration
25	Drive application programming with CODESYS
26	Flexible connectivity to automation networks
27	Input/output extension modules for increased connectivity
27	Speed feedback interfaces for precise process control
27	I/O option extension adapter
27	DDCS communication option modules
27	Remote monitoring access worldwide
28	EMC – electromagnetic compatibility
28 - 29	Brake options, ACS880-604
30 - 31	du/dt filters
31	Dimensioning tool for selecting the optimal drive
32	Expertise at every stage of the value chain
33	Secure uptime throughout the drive life cycle



The all-compatible ACS880 series drives

The ACS880 series drives are part of ABB's all-compatible drives portfolio. Compatible with virtually all types of processes, automation systems, users and business requirements they are designed to tackle any motor-driven application in any industry, despite the power range. The innovation behind all-compatibility is our new drives architecture that simplifies operation, optimizes energy efficiency and helps maximize process output. The ACS880 series consists of single drives, multidrives and drive modules.

Simplifying your world without limiting your possibilities

Wide range of safety features

Safe torque off is built-in as standard. An optional safety functions module provides extended safety functions, simplifying the configuration and reducing installation space.



Drive application programming

Customizable to meet the precise application needs using CODESYS programming. The drive is also easy to integrate with other ABB components such as PLC and HMI.



Direct torque control (DTC)

ABB's signature motor control technology provides precise speed and torque control for all applications and virtually any type of AC motor.



Application control programs

A range of ready-made programs to optimize application productivity and usability.

Removable memory unit

Stores all the software and parameter configurations in an easily replaceable and simple-to-install module.



Energy efficiency

The drive provides features such as an energy optimizer and energy efficiency information that help you monitor and save energy used in the processes.

Remote monitoring access

With a built-in web server, NETA-21 makes worldwide access easy to industry applications.



Drive-to-drive link

Allows fast communication between drives including master-follower configurations without any additional hardware.



Drive modules, ACS880

The all-compatible drives are designed to provide customers across industries and applications with unprecedented levels of compatibility and flexibility. The ACS880 drive modules are customized to meet the precise needs of industries such as metals, oil and gas, mining, marine, material handling, pulp and paper. They control a wide range of applications such as cranes, conveyors, pumps and fans.



Intuitive human-machine interface

Intuitive, high-contrast and high-resolution display enabling easy navigation in multiple languages.



Startup and maintenance tool

PC tool for drive startup, configuration and daily use and process tuning. PC tool is connected to the drive via Ethernet or USB interface.



Communication with all major automation networks

Fieldbus adapters enable connectivity with all major automation networks.



Extended connectivity

In addition to the standard interfaces, the drive has three built-in slots for additional input/output extension modules and speed feedback interfaces.

Flexible product configurations

Drives are built to order with a wide range of options such as braking options and different enclosure variants.



Human all-compatible

The new drives share easy-to-use interfaces saving you time during drive commissioning and maintenance. When you have learned it once, you can use it with all the drives in our all-compatible drives portfolio.

The new control panel supports over 20 languages. The new PC tool provides extensive drive monitoring capabilities and quick access to the drive settings. Integrated and certified safety features provide safety for machine operators.





Process all-compatible

The drives are compatible with all kinds of processes. They control virtually any type of AC motor, provide extensive input/output connectivity and support all major fieldbus protocols. The drives cover a wide voltage and power range. Control performance is scalable from basic to demanding applications delivered by direct torque control (DTC). The flexibility and scalability of the drives enable one drive platform to control virtually any application or process, making your drive selection easy.



Environment all-compatible



There is an increased demand for reducing industries' impact on the environment. Our drives can help you reduce energy consumption in a wide range of applications. The new drives have an energy optimizer feature that ensures maximum torque per ampere, reducing energy drawn from the supply. The built-in energy efficiency calculators help you to analyze and optimize processes. We can help you to investigate the energy saving potential of selected applications with our six-step energy appraisal. Our services expand through the life cycle of the drive and help you maintain energy efficiency from installation and commissioning to drive replacement.





Business all-compatible



The new all-compatible drives are not just equipment but part of your business strategy. Providing better control over your processes, the new drives equal lower energy consumption, improved productivity, flexibility and ease of use. In addition to drives we offer a wide range of products and services to support your business. With offices in over 90 countries and a global technical partner network, we are in a good position to offer technical advice and local support, worldwide.

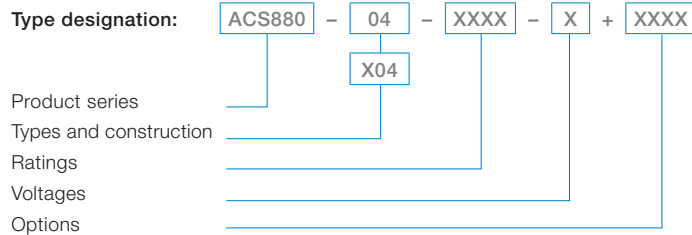
How to select a drive

Many of the features for the ACS880 drive modules are built-in as standard, making selection easy. A wide range of options are available to optimize the drive for different requirements. To choose the right drive for your application, please refer to the rating tables on pages 13, 16 and 17 or use ABB's DriveSize (page 29) dimensioning tool. The selected

drive has a unique type designation, which identifies the drive by construction, power and voltage range. The options are added to the type designation with a "plus" code. Build up your own ordering code using the type designation key or contact your local ABB drives sales office and let them know your needs/requirements.



Technical data



Mains connection

Voltage and power range	3-phase, $U_{N3} = 380$ to 415 V, +10/-15% (-04) 3-phase, $U_{N5} = 380$ to 500 V, +10/-15% (-04) 3-phase, $U_{N3} = 380$ to 415 V, $\pm 10\%$ (-x04, -04 *****) 3-phase, $U_{N5} = 380$ to 500 V, $\pm 10\%$ (-x04, -04 *****) 3-phase, $U_{N7} = 525$ to 690 V, $\pm 10\%$ (-x04, -04 *****) 1.5 to 2200 kW IGBT supply unit (ISU) 300 to 630 kVA Diode supply unit (DSU) 55 to 2700 kVA
Frequency	50/60 Hz $\pm 5\%$
Power factor	IGBT supply unit (ISU): $\cos\phi = 1$ (fundamental) $\cos\phi = 0.99$ (total) Diode supply unit (DSU): $\cos\phi = 0.98$ (fundamental) $\cos\phi = 0.93$ to 0.95 (total)
Efficiency (at nominal power)	98% with DSU 97% with ISU

Motor connection

Voltage	3-phase output voltage 0 to $U_{N3}/U_{N5}/U_{N7}$
Frequency	0 to ± 500 Hz * **
Motor control	Direct torque control (DTC)
Torque control:	Torque step rise time:
Open loop	<5 ms with nominal torque
Closed loop	<5 ms with nominal torque
	Non-linearity:
Open loop	$\pm 4\%$ with nominal torque
Closed loop	$\pm 3\%$ with nominal torque
Speed control:	Static accuracy:
Open loop	10% of motor slip
Closed loop	0.01% of nominal speed
	Dynamic accuracy:
Open loop	0.3 to 0.4% seconds with 100% torque step
Closed loop	0.1 to 0.2% seconds with 100% torque step

Product compliance

- CE
- Low Voltage Directive 2006/95/EC
- Machinery Directive 2006/42/EC
- EMC Directive 2004/108/EC
- Quality assurance system ISO 9001 and Environmental system ISO 14001
- RoHS
- UL ****, cUL UL508C **** and CSA C22.2 NO.14-10 ****, GOST R, C-Tick ****
- Functional safety: STO TÜV Nord certificate (-104)***

EMC according to EN 61800-3 (2004)

- 2nd environment category C3 included as standard (-x04, -04 *****)
- 2nd environment category C3 included as option (-04)
- 2nd environment category C4 included as standard

Environmental limits

Ambient temperature	
Transport	-40 to +70 °C
Storage	-40 to +70 °C
Operation (air-cooled)	-15 to +40 °C as standard (-04) 0 to +40 °C as standard (-x04, -04 *****) +40 to +55 °C with derating of 1%/1 °C (-04) +40 to +50 °C with derating of 1%/1 °C (-x04, -04 *****)
Cooling method	
Air-cooled	Dry clean air
Altitude	
0 to 1,000 m	Without derating
1,000 to 4,000 m	With derating ~ (1%/100 m)
Relative humidity	5 to 95%, no condensation allowed
Degree of protection	
IP00	(-04, -04*****, -X04)
IP20	(-04)
Paint color	RAL 9017, RAL 9002
Contamination levels	No conductive dust allowed
Storage	IEC 60721-3-1, Class 1C2 (chemical gases), Class 1S2 (solid particles)
Transportation	IEC 60721-3-2, Class 2C2 or 3C2 (chemical gases), Class 2S2 (solid particles without air inlet filters)
Operation	IEC 60721-3-3, Class 3C2 (chemical gases), Class 3S2 (solid particles)
Functional safety	
Standard	Safe torque off (STO according EN 61800-5-2) IEC 61508 ed2: SIL 3, IEC 61511: SIL 3, IEC 62061: SIL CL 3, EN ISO 13849-1: PL e
Internal safety option (FSO-11)	Safe stop 1 (SS1), safely-limited speed (SLS), safe stop emergency (SSE), safe brake control, (SBC) and safe maximum speed (SMS) IEC 61508 ed2: SIL 3, IEC 61511: SIL 3, IEC 62061: SIL CL 3, EN ISO 13849-1: PL e TÜV Nord certified ***

C = chemically active substances

S = mechanically active substances

* The operational output frequencies please contact your local ABB office

** For higher operational frequency of the FSO-11 is up to 200 Hz of the drives output

*** Please check availability per drive type

**** -04 pending

***** Single drive module packages

Single drive modules, ACS880-04

Our ACS880-04 single drive modules are optimized for easy and cost efficient cabinet assembly. With a compact and robust cabinet design, they save a lot of floor space and are easy to maintain and service. Being part of the all-compatible ACS880 industrial drives series, the single drive modules are easy to integrate into other systems and they provide great control performance with versatile drive features. This power intensive drive module is compatible with a wide range of industries including oil and gas, mining, metals, chemicals, cement, power plants, material handling, pulp and paper and woodworking. Applications range from cranes, extruders, conveyors, compressors to pumps and fans.

Wide range of features for easy and cost efficient cabinet assembly

The module is designed with all the necessary components for making engineering, cabling and cabinet assembly easier. The module has a pedestal with wheels and a ramp for pushing the module inside the cabinet and connecting it to the optional cable panel. Other features include power input connections on the top of the module and power output on the bottom, for optimized cabinet usage. The control unit can be either installed inside or outside of the module enabling free location of input/output terminals. The built-in features include direct torque control (DTC), ABB's premier motor control technology, chokes for harmonic reduction, safe torque off (STO) and drive-to-drive communication as standard. Additional built-in options include EMC filters, braking chopper and common mode filters, several inputs/outputs terminals, fieldbus connectivity, integrated safety including several safety functions and option slots for speed feedback. The drive comes with IP20 enclosure class as standard, reducing engineering time and cabinet assembly costs. ABB provides an extensive selection of support documentation for planning including dimension drawings in different formats, EPLAN P8 macros and helping in line apparatus selection tool.

Robust design and easy maintenance and service

The module has coated circuit boards as standard with long life time components giving up to 6 years of maintenance interval. The module also comes with several cooling fans that are redundant. Other service features include the removable memory unit that enables moving the drive settings and drive firmware from one drive module to another during maintenance. There is also a service hatch in the module for heat sink cleaning.

Main features include

- Enclosure class IP20 as standard
- Power supply coming from the top part of the module and out from the lower part of the cabinet
- Compact design with robust mechanics
- Easy installation, commissioning and maintenance with pedestal on wheels, ramp and optional cable panel (+H381)
- DTC as standard
- Integrated safety including safe torque off (STO) as standard with the optional safety functions module (FSO-11)
- Supports various motor types including synchronous reluctance motors
- Intuitive control panel with USB connection
- Removable memory unit for easy maintenance
- Drive composer PC tool for commissioning and configuration
- Control unit with three option slots, that can be installed either inside the module or in different part of the cabinet, supporting a wide range of fieldbuses, feedback devices and input/output options
- Redundant fan that enables the industry process to run in part load even with one fan only running
- Coated boards as standard
- Built-in choke as standard for input harmonics reduction
- Built-in braking chopper (option)
- EMC filter option



Single drive modules, ACS880-04



Optional cable panel installed inside the cabinet. ACS880-04 is pushed into the cabinet using a ramp and pedestal on wheels.

High power single drive module packages, ACS880-04

nxD8T supply units and n×R8i inverter units

The ACS880-04 high power single drives module packages include the parallel connected R8i inverter module and D8T half controlled diode bridge with thyristor charging. The power range is from 630 to 2200 kW, and the voltage range is from 380 to 690 V.

These compact multidrive modules come as bookshelf variants. They have been optimized for assembly into customer's own cabinets. Installing and transporting them is easy, as they come equipped with wheels. Connecting the modules to the motor cables inside the cabinet is quick as the modules come with quick connectors as standard. The modules can also be quickly pulled out from a cabinet without any need for disconnecting the motor cables. This is done simply by disconnecting a couple of bolts. The R8i inverter module comes equipped with a removable fan pedestal, which makes motor cabling easy.

The control unit and the input/output connections can be located in the most optimal part inside the cabinet. The circuit boards in the modules are in a sealed compartment, keeping them clean and cool during operation. The cooling fans in the module are speed controlled, helping to lower the noise level of the module and making it more energy efficient. The fans also make the temperature for the semiconductors more stable.

Main features include

- Optimized design for easy cabinet assembly (comes with wheels)
- Compact bookshelf design
- Easy access to power terminals
- Side-by-side mounting
- Direct torque control (DTC) as standard
- Long lifetime cooling fan and capacitors
- Built-in redundancy with parallel connected modules
- Extensive, programmable inputs/output with galvanically isolated inputs
- Integrated safety including safe torque off (STO) as standard with the optional safety functions module (FSO-11)
- Supports various motor types including synchronous reluctance motors
- Removable memory unit for easy maintenance
- Drive composer PC tool for commissioning and configuration
- Control unit BCU-X2 is used with all parallel connected modules, such as n×R8i and DxT. It has three option slots, and a slot for DDCS optical communication.
- The control unit can be installed in different parts of the cabinet, and it supports a wide range of fieldbuses, feedback devices and input/output options
- Coated boards come as standard
- Speed controlled cooling fans
- Large power terminals allowing the use of a wide range of cable sizes
- Complete cabinet design with Rittal TS8 cabinets



ACS880-04 single drive module package with 1×D8T and 2×R8i

Ratings, types and voltages

ACS880-04

$U_N = 400\text{ V}$ (range 380 to 415 V). The power ratings are valid at nominal voltage 400 V (200 to 1400 kW).

Nominal ratings			Light-overload use		Heavy-duty use		Noise level	Heat dissipation	Air flow	Type designation	Frame size
I_N A	I_{max} A	P_N kW	I_{Ld} A	P_{Ld} kW	I_{Hd} A	P_{Hd} kW	dBA	W	m ³ /h		
505	560	250	485	250	361	200	72	5602	1200	ACS880-04-505A-3	R10
585	680	315	575	315	429	250	72	6409	1200	ACS880-04-585A-3	R10
650	730	355	634	355	477	250	72	8122	1200	ACS880-04-650A-3	R10
725	850	400	715	400	566	315	72	8764	1200	ACS880-04-725A-3	R11
820	1020	450	810	450	625	355	72	9862	1200	ACS880-04-820A-3	R11
880	1100	500	865	500	725*	400	71	10578	1420	ACS880-04-880A-3	R11
1140	1482	630	1072	560	787	400	73	16500	3900	ACS880-04-1140A-3	1xD8T+2xR8i
1480	1930	800	1421	800	1107	630	74	24500	5200	ACS880-04-1480A-3	2xD8T+2xR8i
1760	2120	1000	1690	900	1316	710	74	32500	5200	ACS880-04-1760A-3	2xD8T+2xR8i
2610	3140	1400	2506	1400	1952	1000	76	48500	7800	ACS880-04-2610A-3	3xD8T+3xR8i

$U_N = 500\text{ V}$ (range 380 to 500 V). The power ratings are valid at nominal voltage 500 V (200 to 1400 kW).

Nominal ratings			Light-overload use		Heavy-duty use		Noise level	Heat dissipation	Air flow	Type designation	Frame size
I_N A	I_{max} A	P_N kW	I_{Ld} A	P_{Ld} kW	I_{Hd} A	P_{Hd} kW	dBA	W	m ³ /h		
460	533	315	450	315	330	200	72	4403	1200	ACS880-04-460A-5	R10
503	560	355	483	315	361	250	72	5602	1200	ACS880-04-503A-5	R10
583	680	400	573	400	414	250	72	6409	1200	ACS880-04-583A-5	R10
635	730	450	623	450	477	315	72	8122	1200	ACS880-04-635A-5	R10
715	850	500	705	500	566	400	72	8764	1200	ACS880-04-715A-5	R11
820	1020	560	807	560	625	450	71	9862	1200	ACS880-04-820A-5	R11
1067	1387	710	1024	710	798	560	73	19500	3900	ACS880-04-1070A-5	1xD8T+2xR8i
1323	1719	900	1270	900	989	710	74	22500	5200	ACS880-04-1320A-5	2xD8T+2xR8i
1580	2060	1100	1517	1000	1182	800	74	28500	5200	ACS880-04-1580A-5	2xD8T+2xR8i
1984	2579	1400	1905	1300	1484	1000	75	44500	6500	ACS880-04-1980A-5	2xD8T+3xR8i

$U_N = 690\text{ V}$ (range 525 to 690 V). The power ratings are valid at nominal voltage 500 V (800 to 2200 kW).

Nominal ratings			Light-overload use		Heavy-duty use		Noise level	Heat dissipation	Air flow	Type designation	Frame size
I_N A	I_{max} A	P_N kW	I_{Ld} A	P_{Ld} kW	I_{Hd} A	P_{Hd} kW	dBA	W	m ³ /h		
800	1040	800	768	710	598	560	73	14500	3900	ACS880-04-0800A-7	1xD8T+2xR8i
1157	1505	1100	1111	1100	866	800	74	30500	5200	ACS880-04-1160A-7	2xD8T+2xR8i
1653	2149	1600	1587	1500	1237	1200	75	35500	6500	ACS880-04-1650A-7	2xD8T+3xR8i
2300	2990	2200	2208	2000	1720	1600	76	58500	9100	ACS880-04-2300A-7	3xD8T+4xR8i

Nominal ratings

I_N Rated current available continuously without overloadability at 40 °C.

P_N Typical motor power in no-overload use.

I_{max} Maximum output current. Available for 10 seconds at start, then as long as allowed by drive temperature.

Light-overload use

I_{Ld} Continuous current allowing 110% I_{Ld} for 1 min/5 min at 40 °C.

P_{Ld} Typical motor power in light-overload use.

Heavy-duty use

I_{Hd} Continuous current allowing 150% I_{Hd} for 1 min/5 min at 40 °C.

P_{Hd} Typical motor power in heavy-duty use.

The ratings apply at 40 °C ambient temperature. At higher temperatures (up to 55 °C) the derating is 1%/1 °C.

* Continuous current allowing 140% I_{Hd} for 1 min/5 min at 40 °C.

Frame size	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
R10	1462	305	505	161
R11	1662	305	505	199
R8i	1397	240	583	125
D8T	1397	240	583	170

Multidrive modules, ACS880-X04

Our ACS880 multidrive modules are designed to be built into a customer's own cabinet by machine builders and system integrators. The power of the inverter modules is available up to 250 kW. The diode supply unit (DSU) is available up to 850 kVA, and has a supply voltage of 380 to 500 V. The IGBT supply module (ISU) is available up to 630 kVA, and has a supply voltage of 380 to 500 V. Multidrive modules are used for building multidrive configurations. The modules are used in industries such as metals, oil and gas, mining, marine, offshore, material handling machines, pulp and paper, automotive, food and beverage, cement, power, water and wastewater. They control a wide range of applications such as cranes, profile and flat rolling, conveyors, winches, test benches, processing lines, paper machines, pumps and fans. The multidrive modules are built using ABB's common drives architecture and come in several frame sizes.

Rectifiers, inverters, brake options, filters, inputs and outputs options, communication option, documentation and everything else required for a complete drive is available. The drive can control motors in either open loop or closed loop through its high precision motor control platform, direct torque control (DTC). Built-in safety features reduce the need for external safety components.

Main features include

- Compact design for easy cabinet assembly and maintenance
- Diode bridge that is highly reliable with high power density
- IGBT supply modules for regenerative drive systems
- Integrated safety including safe torque off (STO) as standard with several safety functions as options
- Drive composer PC tool for commissioning and configuration
- Intuitive control panel with USB connection
- Primary control program - common software used throughout the ACS880 drive series
- Control unit ZCU-13 for inverter and diode supply unit comes with three option slots for extension option modules
- IGBT supply unit (R8i) uses the BCU-02 control unit that comes with integrated branching unit, power stage link data logger with detachable memory card, embedded Ethernet and three option slots with an additional slot for DDCS communication option
- Supports various motor types including synchronous reluctance motors
- Removable memory unit for easy maintenance
- Coated boards as standard

- Braking options
- Cabinet accessory kits
- Detailed documentation for cabinet assembly

Cabinet assembly accessories simplify installation and connection

Installation of multidrive modules into cabinets is simplified with the use of mechanical and electrical accessories. These accessories are available giving full design to install the modules into RITTAL TS8 cabinets. In addition, generic kit offers great help to install the modules into any other cabinet types that are available. Alternatively, ABB authorized and registered machine builders, system integrators and panel builders can manufacture their own accessory kits by accessing the online engineering support website which features detailed kit drawings. Cabinet assembly accessories help shorten engineering and assembly time as well as reduce the risk of errors.

Using our cabinet assembly accessories and part drawings enable easy and efficient installation, making sourcing the mechanical components more flexible. Other benefits that reduce time required for mechanical engineering include dimensional and assembly drawings with accessories drawings available as 3D images, EPLAN electric P8 macros, module circuit diagrams and installation example videos and animations for cabinets. Training material for cabinet assembly of drives is also available.



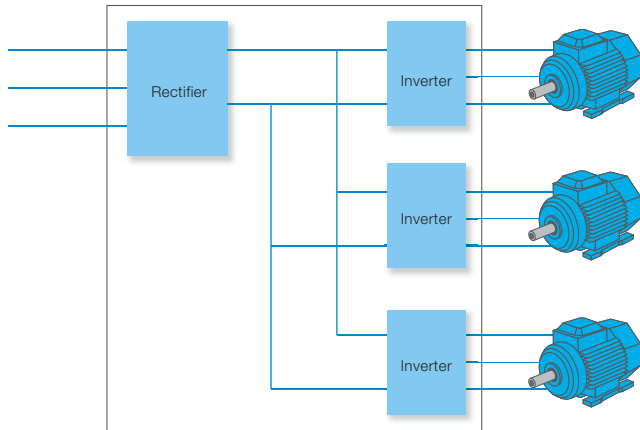
Multidrive modules, ACS880-X04

The multidrive modules are optimized for assembly into customer's own cabinets. The modules have a side-by-side mounting on the assembly plate situated in the cabinet, making module installation faster and easier. Modules with bigger frame sizes are equipped with wheels so they can easily be moved in or out of the cabinet for maintenance purposes. This concept also allows pre-installation of the power cables inside the empty cabinet. Besides the compact design, the new ACS880 inverter and rectifier units include an extensive selection of options.



Frame sizes R1i to R7i

Frame sizes D6D to D8D



IGBT supply modules (ISU)

An IGBT supply module is used in regenerative drives to convert three-phase AC voltage to DC voltage. It is available in R8i frame size with LCL line filter in a power range from 300 to 630 kVA. In power control it gives the same firm but gentle performance as Direct torque control (DTC) gives in motor control. The IGBT module is hardware compatible with drive modules and it can operate in both motoring and generating modes.

The multidrive construction simplifies the total installation and provides many advantages such as:

- Savings in cabling, installation and maintenance costs
- Space savings
- Reduced component count and increased reliability
- Reduced line currents and simpler braking arrangements
- Energy circulation over the common DC busbar, which can be used for motor-to-motor braking without the need for a braking chopper or regenerative supply unit
- Optimized and simple cabinet

The DC voltage is constant and the line current is sinusoidal. The control also provides a near unity power factor. The module can also boost DC voltages eg, when line voltage is low. Harmonic content remains extremely low due to DTC control and LCL line filtering.

Inverter modules (INU)

Inverter modules come in 6 different frame sizes. Frame sizes R1i to R4i and R6i to R7i start from 1.5 to 250 kW. The voltage ranges from 380 to 500 V. Inverter units have built-in capacitors for smoothing the voltage of the DC busbars. The electrical connection to the common DC busbar is fuse protected. An optional switch can be selected to disconnect the whole drive unit. Each inverter unit has a control unit (ZCU) which has slots to place different option adapters, such as input/output extension modules, speed feedback modules and fieldbus adapter modules.

Diode supply modules (DSU)

Supply modules are available as diode based solutions. They come in three different frame sizes (D6D to D8D) and a power range from 50 to 850 kVA. A diode supply unit is used in non-regenerative drive systems to convert three-phase AC voltage to DC voltage. A diode supply unit is controlled by the ZCU control unit. There is no charging circuit in the DSU as the charging is built into the drive units (R1i to R4i and R6i to R7i).



Frame size R8i and LCL line filter

Brake unit

It handles the energy generated by decelerating motors such as emergency stopping. During resistor braking, whenever the voltage in the intermediate circuit of a drive exceeds a certain limit, a braking chopper connects the circuit to a braking resistor.

Ratings, types and voltages

Inverter modules

Inverter modules (INU), ACS880-104

$U_N = 400\text{ V}$ (range 380 to 415 V). The power ratings are valid at nominal voltage 400 V (1.5 to 200 kW).

Nominal ratings			Light-overload use		Heavy-duty use		Noise level	Heat dissipation	Air flow	Type designation	Frame size
I_N A (AC)	I_{max} A (AC)	P_N kW	I_{Ld} A	P_{Ld} kW	I_{Hd} A	P_{Hd} kW	dB(A)	kW	m ³ /h		
4.8	7	1.5	4.5	1.5	4	1.5	47	0.07	24	ACS880-104-004A8-3	R1i
6	8.8	2.2	5.5	2.2	5	1.5	47	0.08	24	ACS880-104-006A0-3	R1i
8	10.5	3	7.6	3	6	2.2	47	0.09	24	ACS880-104-008A0-3	R1i
10.5	13.5	4	9.7	4	9	3	39	0.11	48	ACS880-104-0011A-3	R2i
14	16.5	5.5	13	5.5	11	4	39	0.14	48	ACS880-104-0014A-3	R2i
18	21	7.5	16.8	7.5	14	5.5	39	0.17	48	ACS880-104-0018A-3	R2i
25	33	11	23	11	19	7.5	63	0.20	142	ACS880-104-0025A-3	R3i
35	44	15	32	15	29	11	63	0.30	142	ACS880-104-0035A-3	R3i
44	53	18.5	41	18.5	35	22	71	0.35	200	ACS880-104-0044A-3	R3i
50	66	22	46	22	44	22	71	0.41	200	ACS880-104-0050A-3	R3i
61	78	30	57	30	52	22	70	0.50	290	ACS880-104-0061A-3	R4i
78	100	37	74	37	69	30	70	0.60	290	ACS880-104-0078A-3	R4i
94	124	45	90	45	75	37	70	0.74	290	ACS880-104-0094A-3	R4i
104	125	55	100	55	78	37	70	0.75	290	ACS880-104-0100A-3	R4i
141	183	75	135	75	105	55	71	1.1	650	ACS880-104-0140A-3	R6i
169	220	90	162	90	126	55	71	1.4	650	ACS880-104-0170A-3	R6i
206	268	110	198	110	154	75	71	1.8	650	ACS880-104-0210A-3	R6i
246	320	132	236	132	184	90	71	2	650	ACS880-104-0250A-3	R6i
300	390	160	288	160	224	110	72	2.5	940	ACS880-104-0300A-3	R7i
350	455	200	336	200	262	132	72	3.1	940	ACS880-104-0350A-3	R7i

$U_N = 500\text{ V}$ (range 380 to 500 V). The power ratings are valid at nominal voltage 500 V (1.5 to 250 kW).

Nominal ratings			Light-overload use		Heavy-duty use		Noise level	Heat dissipation	Air flow	Type designation	Frame size
I_N A (AC)	I_{max} A (AC)	P_N kW	I_{Ld} A	P_{Ld} kW	I_{Hd} A	P_{Hd} kW	dB(A)	kW	m ³ /h		
3.6	5.3	1.5	3.4	1.5	3	1.5	47	0.06	24	ACS880-104-003A6-5	R1i
4.8	7	2.2	4.5	2.2	4	1.5	47	0.07	24	ACS880-104-004A8-5	R1i
6	8.8	3	5.5	3	5	2.2	47	0.08	24	ACS880-104-006A0-5	R1i
8	10.5	4	7.6	4	6	3	47	0.09	24	ACS880-104-008A0-5	R1i
10.5	13.5	5.5	9.7	5.5	9	4	39	0.13	48	ACS880-104-0011A-5	R2i
14	16.5	7.5	13	7.5	11	5.5	39	0.15	48	ACS880-104-0014A-5	R2i
18	21	11	16.8	7.5	14	7.5	39	0.18	48	ACS880-104-0018A-5	R2i
25	33	15	23	11	19	11	63	0.23	142	ACS880-104-0025A-5	R3i
30	36	18.5	28	15	24	15	63	0.28	142	ACS880-104-0030A-5	R3i
35	44	22	32	18.5	29	18.5	63	0.32	142	ACS880-104-0035A-5	R3i
50	66	30	46	30	44	22	71	0.48	200	ACS880-104-0050A-5	R3i
61	78	37	57	37	52	30	70	0.55	290	ACS880-104-0061A-5	R4i
78	100	45	74	45	69	45	70	0.65	290	ACS880-104-0078A-5	R4i
94	124	55	90	55	75	45	70	0.80	290	ACS880-104-0094A-5	R4i
113	147	75	108	75	85	55	71	1	650	ACS880-104-0110A-5	R6i
136	177	90	131	90	102	55	71	1.2	650	ACS880-104-0140A-5	R6i
165	215	110	158	110	123	75	71	1.5	650	ACS880-104-0170A-5	R6i
197	256	132	189	132	147	90	71	1.8	650	ACS880-104-0200A-5	R6i
240	312	160	230	160	180	110	71	2	650	ACS880-104-0240A-5	R6i
302	393	200	290	200	226	132	72	2.7	940	ACS880-104-0300A-5	R7i
340	442	250	326	250	254	160	72	3.2	940	ACS880-104-0340A-5	R7i

Nominal ratings

I_N Rated current available continuously without overloadability at 40 °C.

P_N Typical motor power in no-overload use.

I_{MAX} Maximum output current. Available for 10 seconds at start, then as long as allowed by drive temperature.

Light-overload use

I_{Ld} Continuous current allowing 110% I_{Ld} for 1 min/5 min at 40 °C.

P_{Ld} Typical motor power in light-overload use.

Heavy-duty use

I_{Hd} Continuous current allowing 150% I_{Hd} for 1 min/5 min at 40 °C.

P_{Hd} Typical motor power in heavy-duty use.

The ratings apply at 40 °C ambient temperature. At higher temperatures (up to 50 °C) the derating is 1%/1 °C.

Frame size	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
R1i	364	90	234	4
R2i	380	100	312	6
R3i	467	168	313	11
R4i	467	223	382	18
R6i	890	170	456	39
R7i	890	170	456	38

With module covers (R1i to R4i)

Ratings, types and voltages

Supply modules

IGBT supply modules (ISU), ACS880-204

$U_N = 400\text{ V}$ (range 380 to 415 V). The power ratings are valid at nominal voltage 400 V. (151 to 582 kVA)

Nominal ratings				No-overload use	Light-overload use		Heavy-duty use		Noise level	Heat dissipation	Air flow	Type designation	Frame size
I_N A (AC)	I_N A (DC)	I_{max} A (DC)	S_N kVA	P_N kW (DC)	I_{Ld} A (DC)	P_{Ld} kW (DC)	I_{Hd} A (DC)	P_{Hd} kW (DC)	dB(A)	kW	m ³ /h		
210	255	331	151	149	244	143	190	112	72	4.1	1150	ACS880-204-0210A-3	R6i + ALCL-05-5
423	513	667	304	301	492	289	384	225	72	9.3	1300	ACS880-204-0420A-3	1xR8i + BLCL-13-5
576	698	908	414	410	670	393	522	307	72	12.1	1300	ACS880-204-0580A-3	1xR8i + BLCL-13-5
810	982	1277	582	576	943	553	735	431	72	17.4	1300	ACS880-204-0810A-3	1xR8i + BLCL-15-5

$U_N = 500\text{ V}$ (range 380 to 500 V). The power ratings are valid at nominal voltage 500 V. (182 to 631 kVA)

Nominal ratings				No-overload use	Light-overload use		Heavy-duty use		Noise level	Heat dissipation	Air flow	Type designation	Frame size
I_N A (AC)	I_N A (DC)	I_{max} A (DC)	S_N kVA	P_N kW (DC)	I_{Ld} A (DC)	P_{Ld} kW (DC)	I_{Hd} A (DC)	P_{Hd} kW (DC)	dB(A)	kW	m ³ /h		
210	255	331	182	180	244	173	190	135	72	4.2	1150	ACS880-204-0210A-5	R6i + ALCL-05-5
396	480	624	343	340	461	326	359	254	72	9.3	1300	ACS880-204-0400A-5	1xR8i + BLCL-13-5
531	644	837	460	455	618	437	482	341	72	11.6	1300	ACS880-204-0530A-5	1xR8i + BLCL-13-5
729	884	1149	631	625	849	600	661	468	72	16.8	1300	ACS880-204-0730A-5	1xR8i + BLCL-15-5

Diode supply modules (DSU), ACS880-304

$U_N = 400\text{ V}$ (range 380 to 415 V). The power ratings are valid at nominal voltage 400 V. (55 to 679 kVA)

Nominal ratings				No-overload use	Light-overload use		Heavy-duty use		Noise level	Heat dissipation	Air flow	Type designation *)	Frame size
I_N A (AC)	I_N A (DC)	I_{max} A (DC)	S_N kVA	P_N kW (DC)	I_{Ld} A (DC)	P_{Ld} kW (DC)	I_{Hd} A (DC)	P_{Hd} kW (DC)	dB(A)	kW	m ³ /h		
80	98	137	55	53	94	51	78	42	62	0.8	370	ACS880-304-0080A-3+A003+C188	D6D
173	212	297	120	114	203	110	170	92	62	1.3	370	ACS880-304-0170A-3+A003+C188	D6D
327	400	561	227	216	384	208	320	173	62	2.0	720	ACS880-304-0330A-3+A003+C188	D7D
490	600	840	339	324	576	311	480	259	62	3.0	720	ACS880-304-0490A-3+A003+C188	D7D
653	800	1120	452	432	768	415	640	345	65	4.5	900	ACS880-304-0650A-3+A003+C188	D8D
980	1200	1680	679	648	1152	622	960	519	65	6.0	900	ACS880-304-0980A-3+A003+C188	D8D

$U_N = 500\text{ V}$ (range 380 to 500 V). The power ratings are valid at nominal voltage 500 V. (69 to 849 kVA)

Nominal ratings				No-overload use	Light-overload use		Heavy-duty use		Noise level	Heat dissipation	Air flow	Type designation *)	Frame size
I_N A (AC)	I_N A (DC)	I_{max} A (DC)	S_N kVA	P_N kW (DC)	I_{Ld} A (DC)	P_{Ld} kW (DC)	I_{Hd} A (DC)	P_{Hd} kW (DC)	dB(A)	kW	m ³ /h		
80	98	137	69	66	94	63	78	53	62	0.8	370	ACS880-304-0080A-5+A003+C188	D6D
173	212	297	150	143	203	137	170	114	62	1.3	370	ACS880-304-0170A-5+A003+C188	D6D
327	400	561	283	270	384	260	320	216	62	2.0	720	ACS880-304-0330A-5+A003+C188	D7D
490	600	840	424	405	576	389	480	324	62	3.0	720	ACS880-304-0490A-5+A003+C188	D7D
653	800	1120	566	540	768	518	640	432	65	4.5	900	ACS880-304-0650A-5+A003+C188	D8D
980	1200	1680	849	810	1152	778	960	648	65	6.0	900	ACS880-304-0980A-5+A003+C188	D8D

Nominal ratings

I_N	Rated current available continuously without overloadability at 40 °C.
S_N	Nominal apparent power.
P_N	Power in no-overload use.
I_{max}	Maximum output current. Available for 10 seconds at start, otherwise as long as allowed by drive temperature.

Light-overload use

I_{Ld}	Continuous current allowing 110% I_{Ld} for 1 min/5 min at 40 °C.
P_{Ld}	Power in light-overload use.

Heavy-duty use

I_{Hd}	Continuous current allowing 150% I_{Hd} for 1 min/5 min at 40 °C.
P_{Hd}	Power in heavy-duty use.

The ratings apply at 40 °C ambient temperature. At higher temperatures (up to 50 °C) the derating is 1%/1 °C.

Dimensions

Frame size	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
IGBT supply module (ISU)				
R6i	900	170	456	38
R8i	1397	240	583	125
LCL-line filter for IGBT supply module (ISU)				
ALCL-05-5	845	378	305	100
BLCL-13-5	1355	240	505	181
BLCL-15-5	1355	240	505	224
Diode supply modules (DSU)				
D6D	815	170	415	37
D7D	1054	170	417	73
D8D	1397	240	589	173

*) +A003 Uncontrolled diode bridge
+C188 DOL cooling fan

Standard interface and extensions for comprehensive connectivity

The ACS880 drive modules offer a wide range of standard interfaces. In addition the drive has three option slots that can be used for extensions including fieldbus adapter modules,

input/output extension modules, feedback modules and a safety functions module.

Control connections	Description
2 analog inputs (XAI)	Current input: -20 to 20 mA, R_{in} : 100 ohm Voltage input: -10 to 10 V, R_{in} : 200 kohm Resolution: 11 bit + sign bit
2 analog outputs (XAO)	0 to 20 mA, $R_{load} < 500$ ohm Frequency range: 0 to 300 Hz Resolution: 11 bit + sign bit
6 digital inputs (XDI)	Input type: NPN/PNP (DI1 to DI5), NPN (DI6) DI6 can alternatively be used as an input for a PTC thermistor.
Digital input interlock (DIIL)	Input type: NPN/PNP
2 digital inputs/outputs (XDIO)	As input: 24 V logic levels: "0" < 5 V, "1" > 15 V R_{in} : 2.0 kohm Filtering: 0.25 ms As output: Total output current from 24 V DC is limited to 200 mA Can be set as pulse train input and output
3 relay outputs (XRO1, XRO2, XRO3)	250 V AC/30 V DC, 2 A
Safe torque off (XSTO)	For the drive to start, both connections must be closed
Drive-to-drive link (XD2D)	Physical layer: EIA-485
Built-in Modbus	EIA-4z85
Assistant control panel/ PC tool connection	Connector: RJ-45



Control unit ZCU

Example of a typical drive modules input/output connection diagram. Variations maybe possible (please see HW manual for more information).

Relay outputs	XRO1, XRO2, XRO3	
Ready 250 V AC/30 V DC 2 A	NO	3
	COM	2
	NC	1
Running 250 V AC/30 V DC 2 A	NO	3
	COM	2
	NC	1
Faulted(-1) 250 V AC/30 V DC 2 A	NO	3
	COM	2
	NC	1
External power input	XPOW	
24 V DC, 2 A	GND	2
	+24VI	1
Reference voltage and analog inputs	J1, J2, XAI	
AI1/AI2 current/voltage selection	AI1:U	AI2:U
	AI1:I	AI2:I
By default not in use. 0(4) to 20 mA, $R_{in} > 100$ ohm	AI2-	7
	AI2+	6
Speed reference 0(2) to 10 V, $R_{in} > 200$ kohm	AI1-	5
	AI1+	4
Ground	AGND	3
-10 V DC, R_L 1 to 10 kohm	-VREF	2
10 V DC, R_L 1 to 10 kohm	+VREF	1
Analog outputs	XAO	
Motor current 0 to 20 mA, $R_L < 500$ ohm	AGND	4
	AO2	3
Motor speed rpm 0 to 20 mA, $R_L < 500$ ohm	AGND	2
	AO1	1
Drive-to-drive link	J3, XD2D	
Drive-to-drive link termination	ON • OFF	
Drive-to-drive link or built-in Modbus	Shield	4
	BGND	3
	A	2
	B	1
Safe torque off	XSTO	
Safe torque off. Both circuits must be closed for the drive to start.	IN2	4
	IN1	3
	SGND	2
	OUT	1
Digital inputs	XDI	
By default not in use	DI6	6
Constant speed 1 select (1=on)	DI5	5
Acceleration and deceleration select	DI4	4
Reset	DI3	3
Forward (0)/Reverse (1)	DI2	2
Stop (0)/Start (1)	DI1	1
Digital input/outputs	XDIO	
Output: Running	DIO2	2
Output: Ready	DIO1	1
Ground selection	•	
Auxiliary voltage output, digital input interlock	XD24	
Digital input/output ground	DIOGND	5
+24 V DC 200 mA	+24VD	4
Digital input ground	DICOM	3
+24 V DC 200 mA	+24VD	2
By default not in use	DIIL	1
Safety functions module connection	X12	
Control panel/PC connection	X13	
Memory unit connection	X205	

Standard software for scalable control and functionality

The same software, the primary control program, is used across the whole ACS880 series for controlling inverter units and motors. Features such as built-in pre-programmed application macros save time during configuration and drive commissioning. The application macros help set parameters for various functions including:

- Basic setup for input/output control and fieldbus adapter control
- Hand/auto control for local and remote operation
- PID control for closed loop processes
- Sequential control for repetitive cycles
- Torque control
- Four user defined sets, for own parameter settings

Direct torque control (DTC)

The drives are equipped with direct torque control (DTC), ABB's signature motor control platform which supports motors such as induction motors, permanent magnet synchronous motors, servo motors and the new synchronous reluctance motor. DTC helps control the motor from standstill to maximum torque and speed without the necessity of position sensors or encoders. DTC allows high overloadability, gives high starting torque and reduces stress on mechanics.

Energy efficiency information

The drives come with built-in energy efficiency information that helps the user fine-tune processes to ensure optimum energy use. The energy optimizer mode ensures the maximum torque per ampere, reducing energy drawn from the supply. The load profile feature collects drive values with three loggers: two amplitude loggers and one peak value logger. Calculators provide essential energy efficiency information: used and saved electrical energy, CO₂ reduction and money saved.

Additional software features include:

- Adaptive programming
- Automatic reset
- Automatic start
- Access levels
- Constant speeds
- Critical speeds and frequencies
- DC hold
- DC magnetizing
- Diagnostics
- Flux braking
- Jogging
- Mechanical brake control
- Drive-to-drive link for master-follower control
- Oscillation damping
- Power loss ride-through
- Process PID control with trim function
- Programmable inputs and outputs
- Programmable and pre-programmed protection functions
- Speed controller with auto tuning
- Startup assistants
- Scalar control with IR compensation
- User selectable acceleration and deceleration ramps
- User adjustable load supervision/limitation
- Variable slope

Removable memory unit

The removable memory unit stores the standard software that includes user settings, parameter settings and motor data. Situated on the control unit, the memory unit can easily be removed for maintenance, update or replacement purposes. This common type of memory unit is used throughout the ACS880 series.





Application control programs

Our application control programs are developed by working closely with our customers over many years. This results in application programs that include the lessons learned across many customers, and that are designed to give you the flexibility to adapt the programs to your specific needs. These programs enhance application usability and lower energy consumption. They increase safe operation of the applications and reduce the need for a PLC. Other benefits include protection of machinery and optimization of application productivity. The programs also optimize time usage and lower operational costs.

The ACS880 application control programs come with adaptive programming features. This makes fine tuning of the functionality of the ready-made application control programs easy. Additionally, we understand that you may need to use different configurations in your process. That's why each of our control programs comes with the ability to configure up to four different configurations, or "user sets." The ACS880 drives offer integrated safety with safe torque off (STO) functionality as standard. The optional safety functions module, FSO-11, comes with five safety functions including safe brake control (SBC).

Control programs for material handling applications

This control program is dedicated for industrial, harbor, tower and marine deck cranes. It is possible to control crane movements in hoist and trolley and travel motions using the same software. The control program comes with integrated mechanical brake control to assure safe opening and closing of the mechanical disc or drum brakes. Standalone and master-follower functionality is supported along with synchro control of multimotors. The synchro control for common operation of the load functionality makes it possible to lift and lower loads, such as containers, in a smooth and balanced way during transportation. The load speed control function maximizes the hoist speed for the given load and ensures that there is sufficient motor torque in the field weakening area. This minimizes operation time and optimizes crane capacity. Fieldbus and conventional I/O control is supported.

Control program for winder

This control program makes sure that unwinding and winding of a roll of web material, such as textile, plastic and paper is performed optimally. The control program observes the diameter of rolls and tension of the web material and makes sure that the drives controlling different parts of the winder are in sync. Based on the feedback from the dancer or tension measurement of the web, the speed or torque of the drive is adjusted properly. The result is a straightforward, cost-effective solution in web handling. Another feature is the mechanics ID run function that calculates automatically the inertia and friction of the roll. This speeds up the commissioning of the drive.

Control program for artificial oil lifting

This control program increases oil production for PCP (progressive cavity pumps), ESP (electro submersible pumps) or rod pumps. The program does not require any feedback encoder to work, which saves costs and increases reliability. The software also reduces stress on the complete pump system when optimizing fluid production. Backspin functionality is especially suitable for PCP and ESP pumps, which minimizes failure and makes oil pumping safe. Various startup ramp functions are also available. The sensorless control function (pump off control) helps to optimize oil pumping productivity by keeping the energy usage on a pre-determined level.

Control program for centrifuge/decanter

This control program is designed to perform practical programmable sequences for conventional centrifuges. The program optimizes the separation of solids from the liquids in centrifuges, separators or decanter centrifuges. The speed difference of the bowling and scrolling in the decanter centrifuge is controlled by the drive-to-drive functionality available in ACS880 drives.

Intuitive human-machine interface

The assistant control panel features intuitive use and easy navigation. High resolution display enables visual guidance. The panel saves on commissioning and learning time by means of different assistants, making the drive simple to set up and use.

It is possible to organize parameters in different ways and store essential parameters for different configurations for any specialized application needed. The menus and messages can be customized for specific terminology so that each application can be set up and configured to its optimum performance. This makes the drive easier to use with information that is familiar to users. With the panel's text editor, users can also add information, customize text

and label the drive. Powerful backup and restore functions are supported as well as different language versions. The help key provides context sensitive guidance. Faults or warnings can be resolved quickly since the help key provides troubleshooting instructions.

One control panel can be connected to several drives simultaneously using the panel network feature. The user can also select the drive to operate in the panel network. The PC tool can be easily connected to the drive through the USB connector on the control panel. There is also the assistant control panel mounting platform, DPMP-01 IP55 kit available for cabinet door flush mounting.



PC tool for easy startup and maintenance

The Drive composer PC tool offers fast and harmonized setup, commissioning and monitoring for the whole drives portfolio. The free version of the tool provides startup and maintenance capabilities, while the professional version provides additional features such as custom parameter windows, control diagrams of the drive's configuration and safety settings.

The Drive composer tool is connected to the drive using an Ethernet connection or through the USB connection on the assistant control panel. All drive information such as parameter loggers, faults, backups and event lists are gathered into a support diagnostics file with a single mouse click. This provides faster fault tracking, shortens downtime and minimizes operational and maintenance costs.

Drive composer pro

Drive composer pro provides basic functionality, including parameter settings, downloading and uploading files and search parameters. Advanced features such as graphical control diagrams and various displays are also available. The control diagrams save users from browsing long lists of parameters and help to set the drive's logic quickly and easily. The tool has fast monitoring capabilities of multiple signals from several drives in a PC tool network. Full backup and restore functions are also included. Safety settings can be configured with Drive composer pro.



Integrated safety simplifies configuration

Integrated safety reduces the need for external safety components, simplifying configuration and reducing installation space. The safety functionality is a built-in feature of the ACS880, with safe torque off (STO) as standard. Additional safety functions can be commissioned with the optional and compact safety functions module that includes safe stop 1 (SS1), safe stop emergency (SSE), safely-limited speed (SLS), safe brake control (SBC) and safe maximum speed (SMS). The drives' functional safety is designed according to EN IEC 61800-5-2 and complies with the requirements of the European Union Machinery Directive 2006/42/EC.

Safe torque off as standard

Safe torque off (STO) is used to prevent unexpected startup and stopping-related functions, enabling safe machine maintenance and operation. With safe torque off activated, the drive will not provide a rotational field. This prevents the motor from generating torque on the shaft. This function corresponds to an uncontrolled stop in accordance with stop category 0 of EN 60204-1.

The safety functions module

The easy to connect and configure safety functions module FSO-11 comes with a range of safety functions and a self-diagnostic function that meets current safety requirements and standards, in one compact module. Compared to using external safety components, the FSO-11 comes with the supported functions seamlessly integrated with the drive



functionality, reducing the implementation of safety function connections and configuration. Installing FSO-11 results in less needs for cabling and provides a cost-effective solution packed into a single safety functions module to ensure safe drive operation. Commissioning and configuration of the safety functions is done with the Drive composer pro PC tool. The drive and FSO-11 is easy to connect to a safety PLC using PROFIsafe fieldbus adapter module (FENA-11).

The operational frequency of the FSO-11 is up to 200 Hz of the drives output. The safety functions module supports the following safety functions (which achieve up to SIL 3 or PL e (Cat. 3) safety level):

- **Safe stop 1 (SS1)** brings the machine to a stop using a monitored deceleration ramp. It is typically used in applications where the machinery motion needs to be brought to a stop in a controlled way before switching over to the no-torque state.
- **Safe stop emergency (SSE)** can be configured to, upon request, either activate STO instantly (category 0 stop), or first initiate motor deceleration and then, once the motor has stopped, activate the STO (category 1 stop).
- **Safe brake control (SBC)** provides a safe output for controlling the motor's external (mechanical) brakes, together with STO.
- **Safely-limited speed (SLS)** ensures that the specified speed limit of the motor is not exceeded. This allows machine interaction to be performed at slow speed without stopping the drive. FSO-11 comes with four individual SLS settings for speed monitoring.
- **Safe maximum speed (SMS)** monitors that the speed of the motor does not exceed the configured speed limit.

Safety functions module

Option	Option code
FSO-11	+Q973

Drive application programming with CODESYS

Automation Builder, ABB's new software suite for automation engineering, makes programming of industry devices such as drives, PLC's, robots and human machine interfaces (HMI) easy using one integrated engineering suite. The Automation Builder is used both for engineering individual industry devices and for putting together entire automation projects. It is based on CODESYS, a widely used software environment that fulfills many different requirements of industrial automation projects, according to the IEC standard 61131-3. As a single tool, the Automation Builder reduces time typically needed for system configuration and programming. It also reduces the need for installing and maintaining separate programs simultaneously. Automation Builder enables the possibility to do online diagnostic checking of multiple tasks performed by different industrial devices such as ACS880 drives.

Drive application programming

Automation Builder makes it possible for system integrators and machine builders to integrate their desired functionality and know-how directly into ACS880 drives. This is possible as ACS880 drives come with CODESYS programming capability embedded inside the drive. Designing a CODESYS-based application program in the drive makes the end user application run more efficiently, even without a separate programmable controller. It also brings higher end-product quality and requires less need for installation space and wiring.

Automation Builder lets you extend the standard functionality of parameter functions for ACS880 drives. This makes the ACS880 drives very flexible to meet exact requirements set for end user applications. The library management functionality in Automation Builder shortens engineering time as reuse of existing program code is possible. Additional features include the ability to select and use one of five different programming languages, effective program debugging and user password protection.

Integrated engineering suite for operating several industry components together

Using the Drive manager tool embedded in Automation Builder together with ABB's AC500 PLC gives the user online connection to all drives in a fieldbus network. This speeds up commissioning and makes diagnostic of the entire automation system easy. Automation Builder saves all the configuration data of industry devices (including drive parameter settings) and program code to the same project archive. This makes engineering work more consistent and manageable.



Automation Builder

One engineering tool to control all industry devices
System configuration and diagnostic
IEC programming
Common project data handling

Flexible connectivity to automation networks

Our fieldbus adapter modules enable communication between drives, systems, devices and software. Our industrial drives are compatible with a wide range of fieldbus protocols.

The plug-in fieldbus adapter module can easily be mounted inside the drive. Other benefits include reduced wiring costs when compared with traditional input/output connections. Fieldbus systems are also less complex than conventional systems, resulting in less overall maintenance.

Multiple fieldbus connections for flexible control

ACS880 supports two fieldbus connections simultaneously. The user has flexibility of choice for control modes, and the possibility for redundant fieldbus adapters using the same protocol.

Drive monitoring

A set of drive parameters and/or actual signals, such as torque, speed, current, etc., can be selected for cyclic data transfer, providing fast data access.

Drive diagnostics

Accurate and reliable diagnostic information can be obtained through the alarm, limit and fault words.

Drive parameter handling

The Ethernet fieldbus adapter module allows users to build an Ethernet network for drive monitoring and diagnostic and parameter handling purposes.

Cabling

Substituting the large amount of conventional drive control cabling and wiring with a single cable reduces costs and increases system reliability and flexibility.

Design

The use of fieldbus control reduces engineering time at installation due to the modular structure of the hardware and software and the simplicity of the connections to the drives.

Commissioning and assembly

The modular machine configuration allows pre-commissioning of single machine sections and provides easy and fast assembly of the complete installation.

Universal communication with ABB fieldbus adapters

The ACS880 supports the following fieldbus protocols:

Fieldbus adapter modules

Option	Option code	Fieldbus protocol
FPBA-01	+K454	PROFIBUS DP, DPV0/DPV1
FCAN-01	+K457	CANopen®
FDNA-01	+K451	DeviceNet™
FENA-11	+K473	EtherNet/IP™, Modbus TCP, PROFINET IO, PROFIsafe *
FECA-01	+K469	EtherCAT®
FSCA-01	+K458	Modbus RTU
FEPL-02	+K470	PowerLink

* For the PROFIsafe to work PROFINET fieldbus adapter module (FENA-11) and the safety functions module (FSO-11) are required.



Input/output extension modules for increased connectivity

Standard input and output can be extended by using optional analog and digital input/output extension modules. The modules are easily installed in the extension slots located on the control unit.

Analog and digital input/output extension modules

Option	Option code	Connections
FIO-01	+L501	4×DI/O, 2×RO
FIO-11	+L500	3×AI (mA/V), 1×AO (mA), 2×DI/O
FAIO-01	+L525	2×AI(mA/V), 2×AO(mA)
FDIO-01	+L?	3×DI, 2×RO

Speed feedback interfaces for precise process control

ACS880 drives can be connected to various feedback devices, such as HTL pulse encoder, TTL pulse encoder, absolute encoder and resolver. The optional feedback module is installed in the option slot on the drive. It is possible to use two feedback modules at the same time, either of the same type or different type.

Feedback interface modules

Option	Option code	Connections
FEN-01	+L517	2 inputs (TTL pulse encoder), 1 output
FEN-11	+L518	2 inputs (SinCos absolute, TTL pulse encoder), 1 output
FEN-21	+L516	2 inputs (Resolver, TTL pulse encoder), 1 output
FEN-31	+L502	1 input (HTL pulse encoder), 1 output

I/O option extension adapter

For additional I/O option slots the FEA-03 is suitable for this use. An analog and digital input/output extension and speed feedback interface can be installed on the FEA-03. Two extension modules can be installed on each I/O extension slot. The connection to the control unit is via a fiber optic link and the adapter can be mounted on a DIN rail (35 x 7.5 mm).

I/O extension adapter

Option	Option code	Connections
FEA-03	+L515	2×F-type option extension slots

DDCS communication option modules

The FDCO-0X optical DDCS communication options are add-on modules on the ACS880 industrial drives control board. The modules include connectors for two fiber optic DDCS channels. The FDCO-0X modules make it possible to perform master-follower and AC800 M communication.

Option	Option code	Connections
FDCO-01	+L503	Optical DDCS (10 Mbd/10 Mbd)
FDCO-02	+L508	Optical DDCS (5 Mbd/10 Mbd)

Remote monitoring access worldwide

The remote monitoring tool, NETA-21, gives easy access to the drive via the Internet or local Ethernet network. NETA-21 comes with a built-in web server. Being compatible with standard web browsers, it ensures easy access to a web-based user interface. Through the interface the user can configure drive parameters, monitor drive log data, and follow up load levels, run time, energy consumption, I/O data and bearing temperature of the motor connected to the drive.

The user can access the remote monitoring tool web page using 3G modem from anywhere with a standard PC, tablet or a mobile phone. The remote monitoring tool helps to reduce cost when personnel are able to monitor or perform maintenance for unmanned or manned applications in a range of industries. It is also very useful when more than one user wants to access the drive from several locations.

Enhanced monitoring functions

The remote monitoring tool supports process and drive data logging. Values of process variables or drives actual

values can be logged to NETA-21's SD memory card which is situated in the remote monitoring tool or sent forward to a centralized database. NETA-21 does not need an external database as the remote monitoring tool is able to store valuable data of the drive during its entire lifetime.

Unmanned monitoring of processes or devices is ensured by the built-in alarm functions that notify maintenance personnel if a safety level is reached. Alarm history with true time stamps are stored internally to the memory card as well as technical data, which is provided by the drive for troubleshooting purposes. True time stamps are also used with drives that do not have a real time clock as standard for ensuring events of all connected drives.



NETA-21

EMC – electromagnetic compatibility

EMC standards

The EMC product standard (EN 61800-3 (2004)) covers the specific EMC requirements stated for drives (tested with motor and cable) within the EU. EMC standards such as EN 55011 or EN 61000-6-3/4 are applicable to industrial and domestic equipment and systems including components inside the drive. Drive units complying with the requirements of EN 61800-3 are compliant with comparable categories in EN 55011 and EN 61000-6-3/4, but not necessarily vice versa. EN 55011 and EN 61000-6-3/4 do not specify cable length or require a motor to be connected as a load. The emission limits are comparable to EMC standards according to the table below.

1st environment versus 2nd environment

1st environment includes domestic premises. It also includes establishments directly connected without an intermediate transformer to a low voltage power supply network that supplies buildings used for domestic purposes.

2nd environment includes all establishments other than those directly connected to a low voltage power supply network that supplies buildings used for domestic purposes.

EMC standards

EMC according to EN 61800-3 (2004) product standard	EN 61800-3 product standard	EN 55011, product family standard for industrial, scientific and medical (ISM) equipment	EN 61000-6-4, generic emission standard for industrial environments	EN 61000-6-3, generic emission standard for residential, commercial and light-industrial environment
1 st environment, restricted distribution	Category C2	Group 1, Class A	Applicable	Not applicable
2 nd environment, unrestricted distribution	Category C3	Group 2, Class A	Not applicable	Not applicable
2 nd environment, restricted distribution	Category C4	Not applicable	Not applicable	Not applicable

Brake options, ACS880-604

Brake chopper

The air-cooled brake chopper unit includes an NBRA brake chopper module or two parallel-connected NBRA brake chopper modules. The brake chopper handles the energy generated by a decelerating motor. The chopper connects the brake resistor to the intermediate DC circuit whenever the voltage in the circuit exceeds the limit defined by the control program. Energy consumption by the resistor losses lowers the voltage until the resistor can be disconnected.

Brake resistor

The brake resistors are separately available for ACS880 drive modules. Resistors other than the standard option resistors may be used, provided that the specified resistance value is not decreased and that the heat dissipation capacity of the resistor is sufficient for the drive application.



NBRA659

Brake options

ACS880-604 brake chopper and resistor

$U_N = 400\text{ V}$ (range 380 to 415 V)

Nominal ratings					Duty cycle (1min/5min)		Duty cycle (10s/60s)		Noise	Air flow	Type designation	Module type	Resistor type
$P_{br,max}$ kW	R_{min} ohm	I_{max} A	I_{rms} A	$P_{cont.}$ kW	$P_{br.}$ kW	I_{rms} A	$P_{br.}$ kW	I_{rms} A	dB(A)	m ³ /h			
Brake chopper without brake resistor													
230	1.7	384	109	70	230	355	230	355	64	660	ACS880-604-0210-3	NBRA658	-
353	1.2	545	149	96	303	468	353	545	64	660	ACS880-604-0320-3	NBRA659	-
706	2x1.2	1090	298	192	606	936	706	1090	67	1320	ACS880-604-0640-3	2xNBRA659	-
Brake chopper with the resistor													
230	1.7	384	65	42	130	200	224	346	66	2500	ACS880-604-0210-3+D151	NBRA658	2xSAFUR210F575
353	1.2	545	84	54	167	257	287	444	66	2500	ACS880-604-0320-3+D151	NBRA659	2xSAFUR180F460
706	2x1.2	1090	168	108	333	514	575	888	69	5000	ACS880-604-0640-3+D151	2xNBRA659	2x(2xSAFUR180F460)

$U_N = 500\text{ V}$ (range 380 to 500 V)

Nominal ratings					Duty cycle (1min/5min)		Duty cycle (10s/60s)		Noise	Air flow	Type designation	Module type	Resistor type
$P_{br,max}$ kW	R_{min} ohm	I_{max} A	I_{rms} A	$P_{cont.}$ kW	$P_{br.}$ kW	I_{rms} A	$P_{br.}$ kW	I_{rms} A	dB(A)	m ³ /h			
Brake chopper without brake resistor													
268	2.15	380	101	81	268	331	268	331	64	660	ACS880-604-0260-5	NBRA658	-
403	1.43	571	136	109	317	391	403	498	64	660	ACS880-604-0400-5	NBRA659	-
806	2x1.43	1142	272	218	634	782	806	996	67	1320	ACS880-604-0800-5	2xNBRA659	-
Brake chopper with the resistor													
268	2.00	408	45	36	111	137	192	237	66	2500	ACS880-604-0260-5+D151	NBRA658	2x(2xSAFUR125F500)
403	1.35	605	67	54	167	206	287	355	66	2500	ACS880-604-0400-5+D151	NBRA659	2xSAFUR200F500
806	2x1.35	1210	134	108	333	412	575	710	69	5000	ACS880-604-0800-5+D151	2xNBRA659	2x(2xSAFUR200F500)

Heat loss of braking chopper is 1% of braking power

Heat loss of section with braking resistors is the same as braking power

Maximum braking power of the ACS880 equipped with the standard chopper and the standard resistor

$P_{br,max}$	Maximum short time braking power.
R	Recommended braking resistor resistance. Also nominal resistance of corresponding SAFUR resistor.
I_{max}	Maximum peak current per chopper during braking. Current is achieved with recommended resistor resistance.
$P_{cont.}$	Maximum continuous braking power. Continuous power (heat) dissipation of the resistor when placed correctly. Energy E_r dissipates in 400 seconds.
E_r	SAFUR resistor nominal braking capacity without forced cooling. Energy pulse that the resistor assembly will withstand (400 s duty cycle). This energy will heat the resistor element from 40 °C to the maximum allowable temperature.
$P_{br.}$	Braking power during corresponding cycle load: 1min/5min = 1 minute braking with power $P_{br.}$ and 4 minutes unload. 10s/60s = 10 second braking with power $P_{br.}$ and 50 seconds unload.
I_{rms}	Corresponding rms current per chopper during load cycle.
R_{min}	Minimum allowable resistance value for the brake resistor.

Brake chopper	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
NBRA658	584	334	240	26
NBRA659	584	334	240	26

Brake resistor	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
SAFUR210F575	1320	300	345	27
SAFUR125F500	1320	300	345	27
SAFUR180F460	1320	300	345	32
SAFUR200F500	1320	300	345	32

du/dt filters

du/dt filtering suppresses inverter output voltage spikes and rapid voltage changes that stress motor insulation. Additionally, du/dt filtering reduces capacitive leakage currents and high frequency emission of the motor cable as well as high frequency losses and bearing currents in the motor. The need for du/dt filtering depends on the motor insulation. For information on the construction of the motor insulation, consult the manufacturer.

If the motor does not fulfil the following requirements, the lifetime of the motor might decrease. Insulated N-end (non-driven end) bearings and/or common mode filters are also required for motor bearing currents with motors bigger than 100 kW. For more information, please see the ACS880 hardware manuals.

Please see below about how to select a filter according to the motor.

Filter selection table for ACS880

Motor type	Nominal AC supply voltage	Requirements for		
		Motor insulation system	ABB du/dt and common mode filters, insulated N-end motor bearings	
			$P_N < 100$ kW and frame size < IEC 315	100 kW $\leq P_N < 350$ kW or IEC 315 \leq frame size < IEC 400
			$P_N < 134$ hp and frame size < NEMA 500	134 hp $\leq P_N < 469$ hp or NEMA 500 \leq frame size \leq NEMA 580
ABB motors				
Random-wound M2__, M3__ and M4__	$U_N \leq 500$ V	Standard	–	+ N
	500 V < $U_N \leq 600$ V	Standard	+ du/dt	+ du/dt + N
		or Reinforced	–	+ N
	600 V < $U_N \leq 690$ V (cable length ≤ 150 m)	Reinforced	+ du/dt	+ du/dt + N
600 V < $U_N \leq 690$ V (cable length > 150 m)	Reinforced	–	+ N	
Form-wound HX__ and AM__	380 V < $U_N \leq 690$ V	Standard	n/a	+ N + CMF
Old* form-wound HX__ and modular	380 V < $U_N \leq 690$ V	Check with the motor manufacturer	+ du/dt with voltages over 500 V + N + CMF	
Random-wound HX__ and AM__**	0 V < $U_N \leq 500$ V	Enmelled wire with	+ N + CMF	
	500 V < $U_N \leq 690$ V	fiber glass taping	+ du/dt + N + CMF	
HDP	Consult the motor manufacturer.			
Non-ABB motors				
Random-wound and form-wound	$U_N \leq 420$ V	Standard $\hat{U}_{LL} = 1300$ V	–	+ N or CMF
	420 V < $U_N \leq 500$ V	Standard $\hat{U}_{LL} = 1300$ V	+ du/dt	+ du/dt + N or + du/dt + CMF
		or Reinforced: $\hat{U}_{LL} = 1600$ V, 0.2 microsecond rise time	–	+ N or CMF
	500 V < $U_N \leq 600$ V	Reinforced: $\hat{U}_{LL} = 1600$ V	+ du/dt	+ du/dt + N or + du/dt + CMF
		or Reinforced: $\hat{U}_{LL} = 1800$ V	–	+ N or CMF
	600 V < $U_N \leq 690$ V	Reinforced: $\hat{U}_{LL} = 1800$ V	+ du/dt	+ du/dt + N
Reinforced: $\hat{U}_{LL} = 2000$ V, 0.3 microsecond rise time		–	+ N or CMF	

* Manufactured before 1.1.1998. ** For motors manufactured before 1.1.1998, check for additional instructions with the motor manufacturer.

The abbreviations used in the table are defined below

Abbr.	Definition
U_N	Nominal AC line voltage.
\hat{U}_{LL}	Peak line-to-line voltage at motor terminals which the motor insulation must withstand.
P_N	Motor nominal power.
du/dt	du/dt filter at the output of the drive. Available from ABB as an optional add-on kit.
CMF	Common mode filter. Depending on the drive type, CMF is available from ABB as a factory-installed option (+208) or as an optional add-on kit.
N	N-end bearing: insulated motor non-drive end bearing.
n/a	Motors of this power range are not available as standard units. Consult the motor manufacturer.

External du/dt filters for ACS880-04

ACS880-04		Unprotected (IP00)	
400 V	500 V	FOCH0610-70	FOCH0875-70
505A-3	460A-5	x	
585A-3	503A-5	x	
650A-3	583A-5	x	
725A-3	635A-5	x	
	715A-5	x	
820A-3	820A-5		x
880A-3			x

Dimensions and weights of the du/dt filters

du/dt filter	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
FOCH0610-70	662	319	293	65
FOCH0875-70	662	319	293	65

du/dt filters

External du/dt filters for ACS880-104

ACS880-104		Unprotected (IP00)		
400 V	500 V	NOCH0016-60	NOCH0030-60	NOCH0070-60
004A8-3	003A6-5	x		
006A0-3	004A8-5	x		
008A0-3	006A0-5	x		
0011A-3	008A0-5	x		
0014A-3	0011A-5	x		
0018A-3	0014A-5	x		
0025A-3	0018A-5	x		
0035A-3	0025A-5		x	
0044A-3	0030A-5		x	
0050A-3	0035A-5		x	
0061A-3	0050A-5		x	x
0078A-3	0061A-5			x
0094A-3	0078A-5			x
0100A-3	0094A-5			x

Dimensions and weights of the du/dt filters

du/dt filter	Height (mm)	Width (mm)	Depth (mm)	Weight (kg)
NOCH0016-60	195	140	115	2.4
NOCH0030-60	215	165	130	4.7
NOCH0070-60	261	180	150	9.5

Dimensioning tool for selecting the optimal drive

DriveSize is designed to help select the optimal drive, motor or transformer for the application. Based on data supplied by the user, the tool calculates and suggests which drive and motors to use. DriveSize uses technical specifications found in our technical catalogs and manuals. It provides default values which can be changed by the user.

DriveSize creates documents for drive and motor dimensioning based on the load, network and cooling data provided by the user. Dimensioning results can be viewed graphically and numerically in the tool.

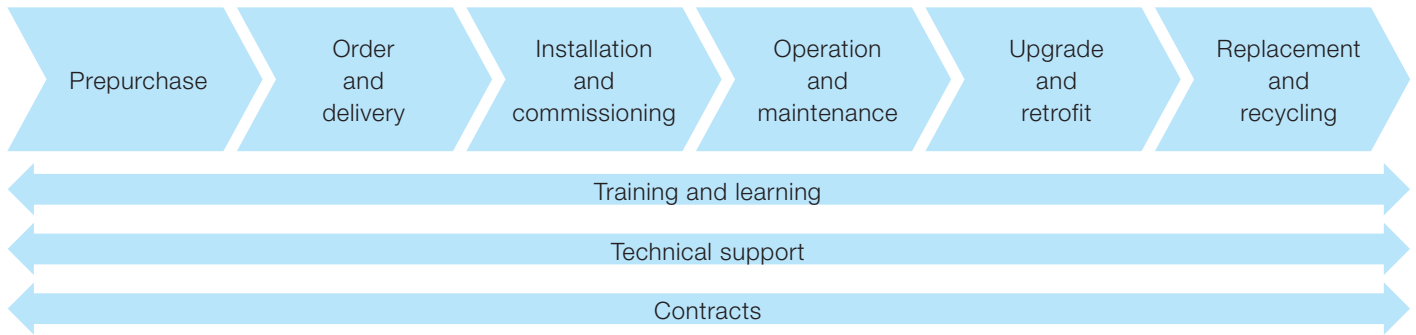
The tool can be used to calculate currents and network harmonics for a single supply unit or a whole system. The user can import a user-defined motor database by using a separate template that comes with the installation package. DriveSize is easy to use and has shortcut keys to make navigation quicker.

Easy to access and use

DriveSize is a free software and can be used either online or downloaded for PC from www.abb.com/drives.



Expertise at every stage of the value chain



The services offered for ABB low voltage drives span the entire value chain, from the moment a customer makes the first enquiry through to disposal and recycling of the drive. Throughout the value chain, ABB provides training and learning, technical support and contracts. All of this is supported by one of the most extensive global drive sales and service networks.

Pre-purchase

ABB provides a range of services that help guide the customers to the right products for their applications. Examples of services include correct drive selection and dimensioning, energy appraisal, harmonic survey and EMC assessment.

Order and delivery

Orders can be placed through any ABB office or through ABB's channel partners. Orders can be placed and tracked online.

ABB's sales and services network offers timely deliveries including express delivery.

Installation and commissioning

While many customers have the resources to undertake installation and commissioning on their own, ABB and its third party channel companies are available to advise or undertake the entire drive installation and commissioning.

Operation and maintenance

Through remote monitoring, ABB can guide the customer through a fast and efficient fault-finding procedure as well as analyze the operation of the drive and the customer's process. From maintenance assessment to preventive maintenance and reconditioning of drives, ABB has all the options covered to keep its customers' processes operational.

Should corrective maintenance of drives be needed, ABB offers on-site and workshop repair, fully backed up by the most extensive spare holding.

Upgrade and retrofit

An existing ABB drive can often be upgraded to the latest software or hardware to improve the performance of the application.

Existing processes can be economically modernized by retrofitting the latest drive technology to mechanical control equipment, such as inlet guide vanes or dampers or older generations of drives.

Instead of replacing an entire drive or drive system, it is often more economical to modernize the old installation by reusing all relevant parts of the original equipment and purchasing new where necessary.

Replacement and recycling

ABB can advise on the best replacement drive while ensuring that the existing drive is disposed in a way that meets all local environmental regulations.

Entire value chain services

The main services available throughout the value chain include:

- Training and learning – ABB offers product and application training in classrooms and on the Internet.
- Technical support – At each stage of the value chain, an ABB expert is available to offer advice to keep the customer's process or plant operational.
- Contracts – Drive care contracts and other types of agreements, from individual services through to complete drive care covering all repairs and even drive replacements, are available.

Secure uptime throughout the drive life cycle

ABB follows a four-phase model for managing the life cycles of its drives. The life cycle phases are active, classic, limited and obsolete. Within each phase, every drive series has a defined set of services.

Examples of individual services are drive selection and dimensioning, installation and commissioning, preventive and corrective maintenance, remote monitoring and intelligent diagnostics, technical support, upgrade and retrofit, replacement and recycling plus training and learning.

In the active phase the drive is in serial production. The drive, with complete life cycle services, is available for purchase.

In the classic phase, the serial production of the drive has ended. The drive, with complete life cycle services, is available for plant extensions.

In the limited phase, the drive is no longer available. The life cycle services are limited. Spare parts as well as maintenance and repair services are available as long as materials can be obtained.

In the obsolete phase, the drive is not available. ABB cannot guarantee availability of services for technical reasons or within reasonable cost.

To ensure the availability of complete life cycle services, ABB recommends that a drive is kept in the active or classic phase by upgrading, retrofitting or replacing.

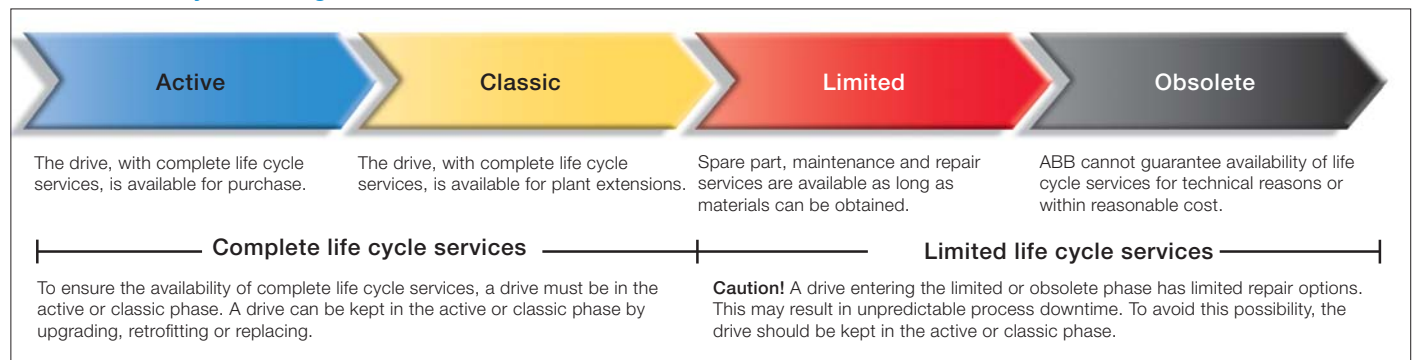
In the classic phase ABB carries out an annual review for each drive life cycle plan. Should any changes to the availability or duration of the services be necessary, ABB gives a life cycle announcement indicating eventual change of life cycle phase and/or any change in the duration of services.

In the limited phase, ABB issues a life cycle phase change announcement, half a year prior to shifting the product into the obsolete phase.

Maximizing return on investment

The four-phase life cycle management model provides customers with a transparent method for managing their investment in drives. In each phase, customers clearly see what life cycle services are available, and more importantly, what services are not available. Decisions on upgrading, retrofitting or replacing drives can be made with confidence.

ABB drive life cycle management model



Contact us

For more information please contact your local ABB representative or visit:

www.abb.com/drives

www.abb.com/drivespartners

© Copyright 2013 ABB. All rights reserved.
Specifications subject to change without notice.



3AUA0000115038 REV D EN 3.7.2013 #16827