

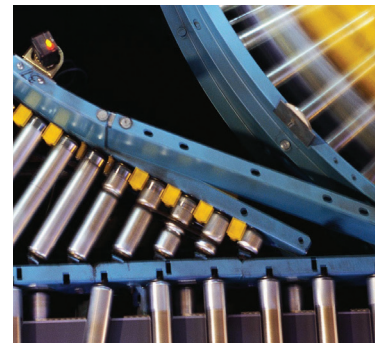
aerospace  
 climate control  
 electromechanical  
 filtration  
 fluid & gas handling  
 hydraulics  
 pneumatics  
 process control  
 sealing & shielding



# AC10 Variable Speed Drive

For Simple, Reliable Motor Control in General Purpose Applications

0.2 - 22 kW Compact Drive



ENGINEERING YOUR SUCCESS.



**WARNING – USER RESPONSIBILITY**

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# Parker Hannifin

## The global leader in motion and control technologies

### Global Product Design

Parker Hannifin has more than 40 years experience in the design and manufacturing of drives, controls, motors and mechanical products. With dedicated global product development teams, Parker draws on industry-leading technological leadership and experience from engineering teams in Europe, North America and Asia.

### Local Application Expertise

Parker has local engineering resources committed to adapting and applying our current products and technologies to best fit our customers' needs.

### Manufacturing to Meet Our Customers' Needs

Parker is committed to meeting the increasing service demands that our customers require to succeed in the global industrial market. Parker's manufacturing teams seek continuous improvement through the implementation of lean manufacturing methods throughout the process. We measure ourselves on meeting our customers' expectations of quality and delivery, not just our own. In order to meet these expectations, Parker operates and continues to invest in our manufacturing facilities in Europe, North America and Asia.

### Electromechanical Worldwide Manufacturing Locations

#### Europe

Littlehampton, United Kingdom  
Dijon, France  
Offenburg, Germany  
Filderstadt, Germany  
Milan, Italy

#### Asia

Wuxi, China  
Chennai, India

#### North America

Rohnert Park, California  
Irwin, Pennsylvania  
Charlotte, North Carolina  
New Ulm, Minnesota



Offenburg, Germany

### Local Manufacturing and Support in Europe

Parker provides sales assistance and local technical support through a network of dedicated sales teams and authorized technical distributors throughout Europe.

For contact information, please refer to the Sales Offices on the back cover of this document or visit [www.parker.com](http://www.parker.com)



Milan, Italy



Littlehampton, UK



Filderstadt, Germany



Dijon, France

# Variable Speed Drive - AC10 Series

## Overview

### Description

The AC10 Compact Drive is a simple, reliable and economical solution to every-day motor control applications requiring speed or torque control within the power range of 0.2 kW to 22 kW. Having compact dimensions and features normally only associated with higher specification drives, including, sensorless vector mode for control of Permanent Magnet (PMAC) and AC induction motors, output frequency up to 590 Hz, 3 phase 400 V supplies in all 5 frame sizes and a full 150 % overload at 0.5 Hz for 1 minute, AC10 provides an optimised solution for OEM machine builders looking for a compact, cost-effective drive without compromising on performance.

### Features

#### Simplicity

AC10 is designed to reduce the time and effort required to install, setup and commission through its easy to use integrated keypad. Minimal wiring requirements and two easily accessed terminal rails make AC10 fast and simple to install, having you up and running in no time at all. Auto-tuning sensorless vector mode takes AC10 beyond simple V/Hz control allowing users requiring greater dynamic speed or torque control for their application to benefit from the drives enhanced 0.5 % speed and 5 % torque accuracy.

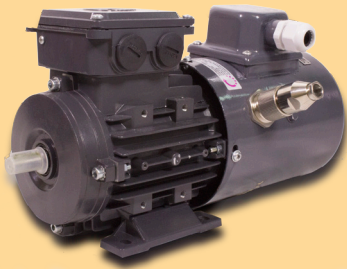
#### Reliability

Proven technology and manufacturing techniques ensure AC10 has been engineered and built to deliver consistently outstanding levels of performance day in, day out ensuring maximum uptime and productivity. Thanks to its conformally coated PCBs, AC10 is able to withstand even the most arduous class 3C3 environment which many other drives in this class would struggle with, allowing you to operate AC10 with the utmost confidence in more applications



## Technical Characteristics - Overview

<b>Power Supply</b>	220 ... 240 VAC ±15 % Single Phase 220 ... 240 VAC ±15 % Three Phase 380 ... 480 VAC +10 % -15 % Three Phase
<b>Input Frequency</b>	50/60 Hz
<b>Power Range</b>	0.2...22 kW
<b>Operating Temperature</b>	0...40 °C
<b>Protection</b>	IP20
<b>Analogue Inputs</b>	2x (0-10 V, 0-5 V, 0-20 mA, 4-20 mA)
<b>Analogue Outputs</b>	1x (0-10 V, 0-20 mA)
<b>Digital Inputs</b>	5x 24 VDC
<b>Digital Outputs</b>	1x 24 VDC
<b>Relay Output</b>	1x 5 A @230 VAC

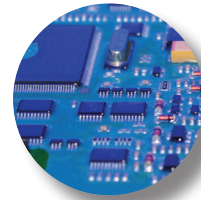


### IE2 Efficiency MR Series AC Induction Motors

An ideal complement to AC10, the MR Series AC Induction motors are IE2 efficient and start from a power range of 0.09 kW. Featuring optional axial in-line force ventilation fan and holding brake, the MR motor is a high quality durable AC motor which when matched to the AC10 will provide you with a complete motor/drive package that will deliver optimal performance in your application.

### AC10 Drives Range

One of the smallest compact-drives available and with five different frame sizes covering a power range of 0.2 kW through to 22 kW, AC10 is a low-cost, compact solution for simple AC induction motor control in a wide range of applications across a host of different industries.



### Suited to all environments

- Optional Internal EMC filter allows use in C3 industrial environments
- Conformal coating provides protection in arduous class 3C3 environments
- Global availability and support
- 50 °C operating temperature
- Fan-cooled heatsink, convection cooled electronics



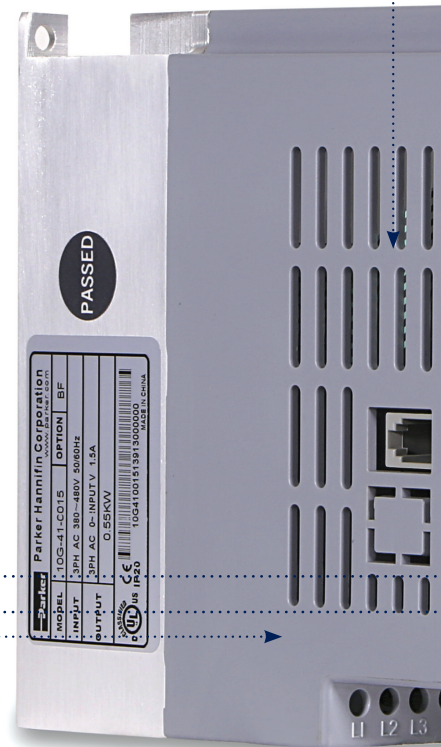
### Flexible I/O

- Freely assignable digital inputs and outputs, and relay output to suit your application needs
- 1 analogue output and 2 analogue inputs for connection to speed potentiometers and panel meters
- Internal dynamic brake switch as standard



### Modbus/RS485 communication

- Connection to Parker PDB drive setup and monitoring tool
- Connection to PLC or other Modbus RTU / RS485 network



### Extra power when it's needed

- 150 % overload for 60 seconds at 0.5 Hz to provide extra starting torque for shifting high inertia loads
- Output power can be uprated for operation in lower ambient temperatures



### Simple or enhanced performance

- Simple V/Hz control for general energy saving applications
- Enhanced auto-tuning sensorless vector control providing higher dynamic performance for applications requiring greater speed or torque accuracy
- Sensorless PMAC & AC Induction Motor control



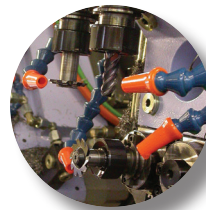
### All at the touch of a button

- Standard ergonomic keypad providing full access to all drive functions
- 4 LEDs provide instant indication of drive status
- Remote mountable keypad option for ease of setup and operation



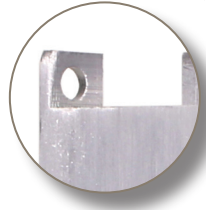
### Simplified Setup

- Simple out of the box operation thanks to integrated macros and quick start guide
- Basic speed control
- Speed preset
- Raise / Lower
- Auto / Man
- PID control
- Essential services (Fire Mode)
- Catch a spinning load (Fly-Catching)



### High Speed Operation

- Up to 590 Hz output for high speed operations such as spindles, centrifuges, mixers etc.



### Compact Dimensions

- When compared to other compact drives of similar functionality, AC10 is noticeably more compact reducing cabinet space and freeing up valuable floor space.



### Control at your fingertips

AC10 comes complete with an ergonomic operator keypad as standard featuring 4 LED drive status indicators, a 4 digit 7 segment LED display and a tactile membrane style keypad. In addition to displaying status and running information, the LED display is also used to access drive configuration parameters which can be quickly and easily changed via the keypad.

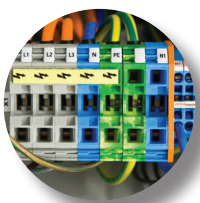
The keypad can also be used to take local control of the motor to start, stop, increase or decrease motor speed. An optional keypad is also available and can be mounted remotely from the drive.

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An optional keypad is also available and can be mounted remotely from the drive.

### Sensorless Permanent Magnet (PMAC) Motor Control

AC10 is capable of providing control of any sensorless PMAC motor, such as the Parker NX series. Servo motor technology can deliver up to 10 % more energy savings than conventional induction motors and can also be up to 75 % smaller in size.



### Choice of operating voltages

- 230 V single and three phase input up to 2.2 kW
- 400 V three phase input from 0.2 kW through to 22 kW

## Applications

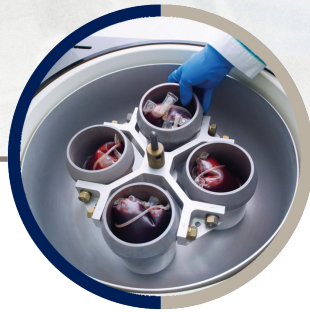
AC10 provides a no-fuss approach to general purpose industrial motor control applications across a wide range of industries, giving users the benefits of the inherent energy-saving properties of using a variable speed drive, as well as the improved reliability and extended service life benefits associated with smoother starting and stopping of regularly cycling loads.

### Typical applications for AC10 include...

- Conveyor
- Centrifuge
- Fans
- Mixers
- Packaging Machines
- Textile Machines
- Strapping Machines
- Labelling Machines
- Industrial Washing Machines
- Machine Tool Spindles
- Roller Doors



Conveyors



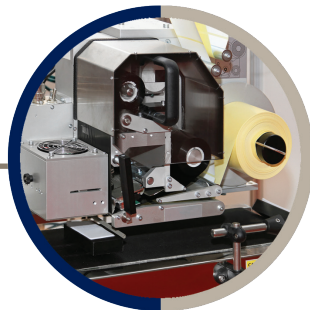
Centrifuges



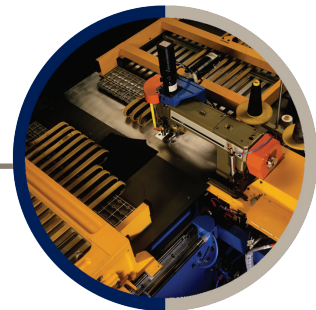
Fans



Mixers



Packaging Machines



Textile Machines



## Technical Characteristics

### Power Ratings

230 V Single Phase Input / 230 V Three phase Input		
Nominal Power [kW]	Output Current [A]	Frame Size
0.2	1.5	1
0.4	2.5	1
0.55	3.5	1
0.75	4.5	1
1.1	5	2
1.5	7	2
2.2	10	2

400 V Three phase Input		
Nominal Power [kW]	Output Current [A]	Frame Size
0.2	0.6	1
0.4	1	1
0.55	1.5	1
0.75	2	2
1.1	3	2
1.5	4	2
2.2	6.5	2
3	8	3
4	9	3
5.5	12	3
7.5	17	4
11	23	4
15	32	5
18.5	38	5
22	44	5

### Electrical Characteristics

<b>Power Supply</b>	220 ... 240 VAC $\pm 15\%$ Single Phase 220 ... 240 VAC $\pm 15\%$ Three Phase 380 ... 480 VAC $+10\%$ $-15\%$ Three Phase
<b>Rated Input Frequency</b>	50/60 Hz
<b>Maximum Switching Frequency</b>	10 kHz without derating
<b>Overload</b>	150% of Rated Current for 60s, 200% for 2s
<b>Output Frequency</b>	0.5...590 Hz
<b>Switching Frequency</b>	2...10kHz selectable
<b>Control Mode</b>	Volts/Hertz or Sensorless Vector (SLV) Mode
<b>Earth Leakage Current</b>	>10 mA (all models)

## Environmental Characteristics

<b>Temperature range</b>	Operating Temperature: 0...+50 °C, derate above 40 °C
<b>Humidity</b>	Operating humidity: Below 90 % Relative Humidity, non-condensing
<b>Vibration</b>	Below 0.5 g
<b>Altitude</b>	1000 m ASL
<b>Protection Degree</b>	IP20
<b>Chemically Active Substances</b>	For the standard product, compliance with EN60271-3-3 is Class 3C3

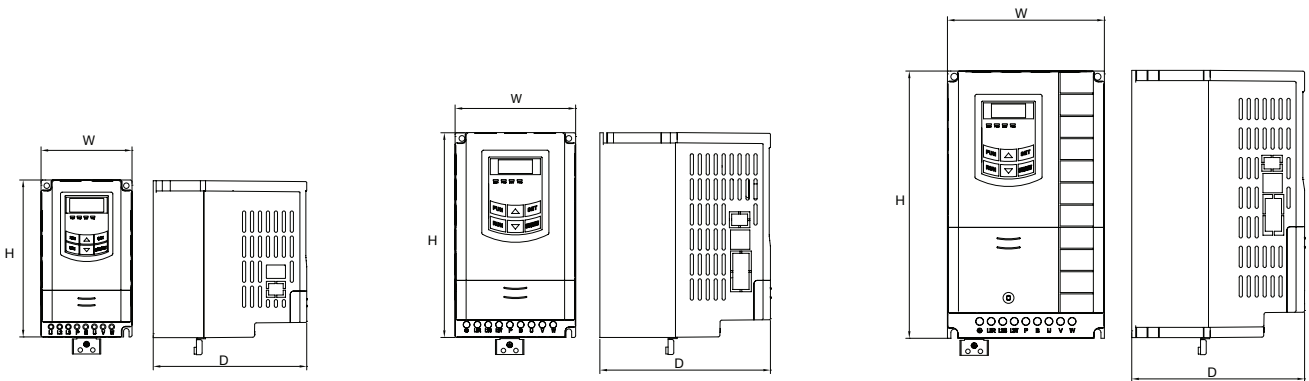
## Standards and Conformance

<b>Overvoltage Category</b>	Overvoltage category III (numeral defining an impulse withstand level)
<b>EMC Compatibility</b>	Meets the requirements of IEC/EN61800-3 : 2004 “Adjustable speed electrical power drive systems – Part 3”
<b>European Certification</b>	This product conforms with the Low Voltage Directive 2006/95/EC
<b>North American Certification</b>	Complies with the requirements of UL508C and CSA 22.2 #14 as an open type drive

## Dimensions

Dimensions [mm]

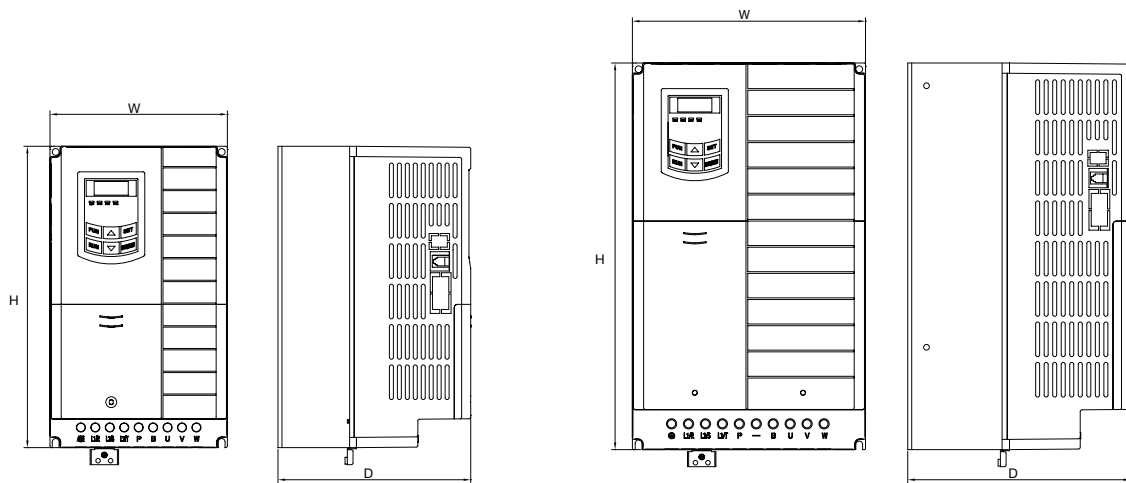
AC10				
Frame	Height (H)	Width (W)	Depth (D)	Weight [kg]
1	138	80	135	1.25
2	180	106	150	1.76
3	235	138	152	2.96
4	265	156	170	4.9
5	340	205	196	7.5



Frame 1

Frame 2

Frame 3



Frame 4

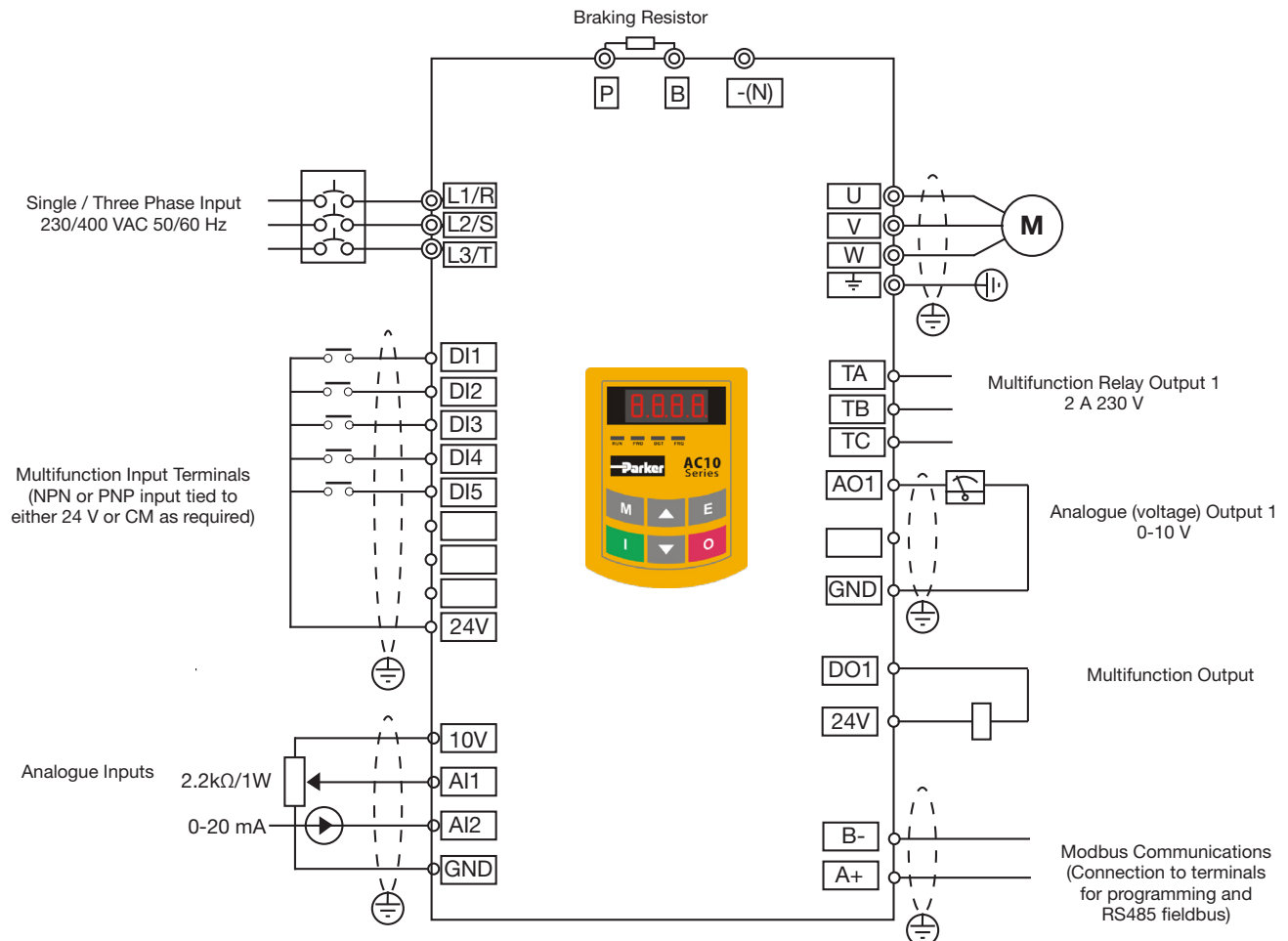
Frame 5

## Connections

Terminal	Description
L1/R	Single or three phase input L1
L2/S	Single or three phase input L2
L3/T	Three phase input L3
P	Braking Resistor
B	Braking Resistor
U	Motor Output 1/U
V	Motor Output 2/V
W	Motor Output 3/W

Terminal	Description
TA	Alarm N/O Relay Contact 5 A 24 VDC
TB	Alarm N/C Relay Contact 5 A 24 VDC
TC	Drive Alarm Common
DO1	Digital Output 1
24V	24 VDC Digital Output (max 50 mA)
CM	0 V DC Common
DI1	Digital Input 1
DI2	Digital Input 2
DI3	Digital Input 3
DI4	Digital Input 4
DI5	Digital Input 5
10V	10 V Reference supply (max 20 mA)
AI1	Analogue input 1
AI2	Analogue input 2
GND	Power Supply 0 V
AO1	Analogue Output
A+	RS485 Channel A
B-	RS485 Channel B

- Analogue Inputs 2: (0-10 V, 0-5 V, 0-20 mA, 4-20 mA)
- Analogue Output 1: (0-10 V, 0-20 mA)
- Digital Inputs 5: Nominal 24 VDC
- Digital Output 1: Nominal 24 VDC
- Relay Output 1: Volt free contact, 5 A @230 VAC max.



## Accessories and Options

### Remote Mounting Keypad

The remote mounting keypad allows users to mount the keypad away from the drive, such as on the door of an electrical enclosure, allows users to configure, operate and monitor the drive without having to access the drive directly.

The remote keypad provides the same functionality as the drive mounted keypad and is connected to the drive via a 1.5 m cable plugged into the port on the left hand side of the drive.



Order Code	Description
1001-00-00	Remote Keypad

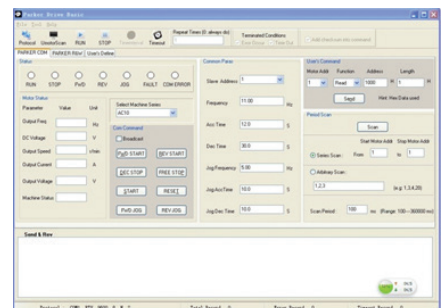
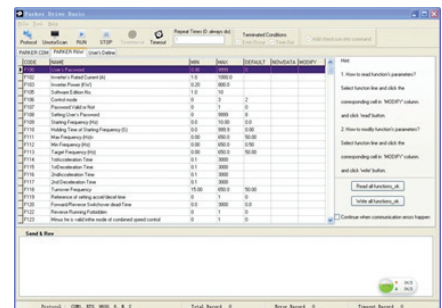
### Software - Parker Drive Basic (PDB)

#### Free Configuration and Diagnostic Monitoring Software

Parker Drive Basic is a monitoring and configuration software tool for use with AC10 Variable Speed Drives. Parker Drive Basic is available as a free download from the Parker website.

Connecting to the AC10 over Modbus, Parker Drive Basic enables users to import, modify and export drive parameters as well as providing a convenient means of starting, stopping and monitoring the operation of the drive.

Note: a USB/RS485 adapter is required to enable connection between PC and drive



## Braking Resistor

During deceleration, or with an over-hauling load, the motor acts as a generator. Energy flows back from the motor into the DC link capacitors within the drive, causing their voltage to rise. If this voltage exceeds a maximum value, the drive will trip to protect the capacitors and internal power devices. The amount of energy that can be absorbed by the capacitors can vary between different applications causing the drive to trip on overvolts. To increase the drive's dynamic braking capability, high power resistor(s), connected across the DC link, allow the dissipation of this excess energy for short term stoppage or braking.



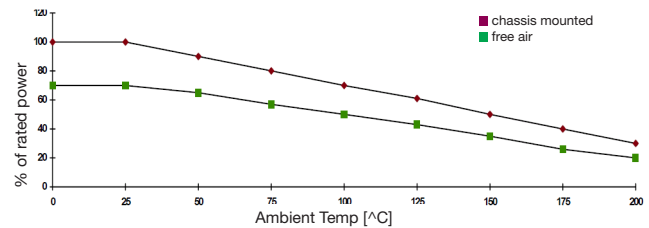
### Brake resistor selection

Brake resistor assemblies must be rated to absorb both peak braking power during deceleration and the average power over the complete cycle.

$$\text{Peak braking power} = \frac{0.0055J \times (n_1^2 - n_2^2) (W)}{t_b}$$

$$\text{Average braking power } P_{av} = \frac{P_{pk} \times t_b}{t_c}$$

J: total inertia [kgm<sup>2</sup>]  
n<sub>1</sub>: initial speed [min<sup>-1</sup>]  
n<sub>2</sub>: final speed [min<sup>-1</sup>]  
t<sub>b</sub>: braking time [s]  
t<sub>c</sub>: cycle time [s]

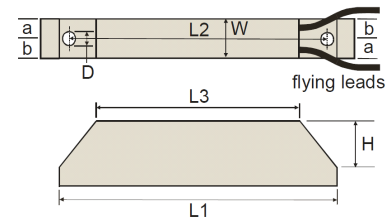


### Resistors above 500 W

Resistors above 500 W are available upon request :

- IP20 protection up to 3 kW
- IP13 protection between 4.2 and 9.8 kW

Model	Impedance [Ω]	Nom. Power [W]	Dimensions [mm]							
			L1	L2	L3	W	H	D	a	b
CZ467715	500	60	100	87	60	22	41	4.3	10	12
CZ467714	200	100	165	152	125	22	41	4.3	10	12
CZ389853	100	100	165	152	125	22	41	4.3	10	12
CZ467717	100	200	165	146	125	30	60	4.3	13	17
CZ463068	56	200	165	146	125	30	60	4.3	13	17
CZ388397	56	200	165	146	125	30	60	4.3	13	17
CZ388396	36	500	335	316	295	30	60	4.3	13	17
CZ467716	28 x 2	500	335	316	295	30	60	4.3	13	17



Overload 5 s: 500 %  
Overload 3 s : 833 %  
Overload 1 s: 2500 %

Variable Speed Drive - AC10  
Accessories and Options

Power Rating [kW]	R1 Resistor Order Code	R2 Resistor Order Code	Connected	Minimum resistance [Ω]	Braking Power [W]
<b>230 V Single Phase</b>					
0,2	CZ467717	-		60	150
0,37	CZ467717	-		60	150
0,55	CZ467717	-		60	150
0,75	CZ467717	-		60	150
1,1	CZ467717	-		60	150
1,5	CZ467717	-		60	150
2,2	CZ467717	-		60	150
<b>230 V Three Phase</b>					
0,37	CZ467717	-		60	150
0,55	CZ467717	-		60	150
0,75	CZ467717	-		60	150
1,1	CZ467717	-		60	150
1,5	CZ467717	-		60	150
2,2	CZ467717	-		60	150
<b>400 V Three Phase</b>					
0,2	CZ467715	-		500	80
0,37	CZ467715	-		500	80
0,55	CZ467715	-		500	80
0,75	CZ467714	-		200	80
1,1	CZ467714	-		150	80
1,5	CZ467714	-		150	80
2,2	CZ467714	-		150	150
3	CZ467714	-		150	150
4	CZ467714	-		150	150
5,5	CZ467716	CZ467716		120	250
7,5	CZ388396	CZ388396		120	500
11	CZ467716	CZ467716		90	1000
15	SY-004655	-		80	1500

Note: The above resistors are only provided as a guide. Please use our calculation guide to confirm accurate braking resistor requirements.

## Output Choke

To reduce capacitive currents and prevent nuisance tripping in installations with longer cable runs, a choke may be fitted to the drives output in series with the motor.

Order Code	Motor Power Normal Duty [kW]	Choke Inductance [mH]	Current [A <sub>rms</sub> ]
CO55931	1.1	2	7.5
	1.5		
	2.2		
	3.0		
CO57283	4.0	0.9	22
	5.5		
	7.5		
CO57284	11	0.45	33
	15		
CO57285	18.5	0.3	44
	22		



## EMC Filter

A range of custom designed optional EMC (Electromagnetic Compatibility) filters are available for use with AC10. They are used to help achieve conformance with EMC directive BS EN61800-3.

AC10 can be ordered with an EMC filter fitted that meets the requirements of a class C3 environment. For class C2 or C1 environments, please contact your local sales office.



# Order Code

## AC10

	1	2		3	4		5		6	7
Order example	10	G	-	1	1	-	0015	-	B	N

<b>1</b>	<b>Device Family</b>	
10	AC10 Variable Speed Drive	
<b>2</b>	<b>Industry</b>	
G	General Purpose	
<b>3</b>	<b>Voltage</b>	
1	230 V Single Phase	
3	230 V Three Phase	
4	400 V Three Phase	
<b>4&amp;5</b>	<b>Frame Size &amp; Rating</b>	
<b>230 V Supply</b>		
1	0015	0.2 kW
1	0025	0.37 kW
1	0035	0.55 kW
1	0045	0.75 kW
2	0050	1.1 kW
2	0070	1.5 kW
2	0100	2.2 kW
<b>400 V Supply</b>		
1	0006	0.2 kW
1	0010	0.37 kW
1	0015	0.55 kW
2	0020	0.75 kW
2	0030	1.1 kW
2	0040	1.5 kW
2	0065	2.2 kW
3	0080	3.0 kW
3	0090	4.0 kW
3	0120	5.5 kW
4	0170	7.5 kW
4	0230	11 kW
5	0320	15 kW
5	0380	18.5 kW
5	0440	22 kW
<b>6</b>	<b>Braking Module</b>	
B	Braking Module Fitted	
<b>7</b>	<b>EMC Filter</b>	
N	No Filter Fitted	
F	C3 EMC Filter Fitted	





# Parker's Motion & Control Technologies

At Parker, we're guided by a relentless drive to help our customers become more productive and achieve higher levels of profitability by engineering the best systems for their requirements. It means looking at customer applications from many angles to find new ways to create value. Whatever the motion and control technology need, Parker has the experience, breadth of product and global reach to consistently deliver. No company knows more about motion and control technology than Parker. For further info call 00800 27 27 5374



## Aerospace

### Key Markets

Aftermarket services  
Commercial transports  
Engines  
General & business aviation  
Helicopters  
Launch vehicles  
Military aircraft  
Missiles  
Power generation  
Regional transports  
Unmanned aerial vehicles

### Key Products

Control systems & actuation products  
Engine systems & components  
Fluid conveyance systems & components  
Fluid metering, delivery & atomization devices  
Fuel systems & components  
Fuel tank inerting systems  
Hydraulic systems & components  
Thermal management  
Wheels & brakes



## Climate Control

### Key Markets

Agriculture  
Air conditioning  
Construction Machinery  
Food & beverage  
Industrial machinery  
Life sciences  
Oil & gas  
Precision cooling  
Process  
Refrigeration  
Transportation

### Key Products

Accumulators  
Advanced actuators  
CO<sub>2</sub> controls  
Electronic controllers  
Filter driers  
Hand shut-off valves  
Heat exchangers  
Hose & fittings  
Pressure regulating valves  
Refrigerant distributors  
Safety relief valves  
Smart pumps  
Solenoid valves  
Thermostatic expansion valves



## Electromechanical

### Key Markets

Aerospace  
Factory automation  
Life science & medical  
Machine tools  
Packaging machinery  
Paper machinery  
Plastics machinery & converting  
Primary metals  
Semiconductor & electronics  
Textile  
Wire & cable

### Key Products

AC/DC drives & systems  
Electric actuators, gantry robots & slides  
Electrohydraulic actuation systems  
Electromechanical actuation systems  
Human machine interface  
Linear motors  
Stepper motors, servo motors, drives & controls  
Structural extrusions



## Filtration

### Key Markets

Aerospace  
Food & beverage  
Industrial plant & equipment  
Life sciences  
Marine  
Mobile equipment  
Oil & gas  
Power generation & renewable energy  
Process  
Transportation  
Water Purification

### Key Products

Analytical gas generators  
Compressed air filters & dryers  
Engine air, coolant, fuel & oil filtration systems  
Fluid condition monitoring systems  
Hydraulic & lubrication filters  
Hydrogen, nitrogen & zero air generators  
Instrumentation filters  
Membrane & fiber filters  
Microfiltration  
Sterile air filtration  
Water desalination & purification filters & systems



## Fluid & Gas Handling

### Key Markets

Aerial lift  
Agriculture  
Bulk chemical handling  
Construction machinery  
Food & beverage  
Fuel & gas delivery  
Industrial machinery  
Life sciences  
Marine  
Mining  
Mobile  
Oil & gas  
Renewable energy  
Transportation

### Key Products

Check valves  
Connectors for low pressure fluid conveyance  
Deep sea umbilicals  
Diagnostic equipment  
Hose couplings  
Industrial hose  
Mooring systems & power cables  
PTFE hose & tubing  
Quick couplings  
Rubber & thermoplastic hose  
Tube fittings & adapters  
Tubing & plastic fittings



## Hydraulics

### Key Markets

Aerial lift  
Agriculture  
Alternative energy  
Construction machinery  
Forestry  
Industrial machinery  
Machine tools  
Marine  
Material handling  
Mining  
Oil & gas  
Power generation  
Refuse vehicles  
Renewable energy  
Truck hydraulics  
Turf equipment

### Key Products

Accumulators  
Cartridge valves  
Electrohydraulic actuators  
Human machine interfaces  
Hybrid drives  
Hydraulic cylinders  
Hydraulic motors & pumps  
Hydraulic systems  
Hydraulic valves & controls  
Hydrostatic steering  
Integrated hydraulic circuits  
Power take-offs  
Power units  
Rotary actuators  
Sensors



## Pneumatics

### Key Markets

Aerospace  
Conveyor & material handling  
Factory automation  
Life science & medical  
Machine tools  
Packaging machinery  
Transportation & automotive

### Key Products

Air preparation  
Brass fittings & valves  
Manifolds  
Pneumatic accessories  
Pneumatic actuators & grippers  
Pneumatic valves & controls  
Quick disconnects  
Rotary actuators  
Rubber & thermoplastic hose & couplings  
Structural extrusions  
Thermoplastic tubing & fittings  
Vacuum generators, cups & sensors



## Process Control

### Key Markets

Alternative fuels  
Biopharmaceuticals  
Chemical & refining  
Food & beverage  
Marine & shipbuilding  
Medical & dental  
Microelectronics  
Nuclear Power  
Offshore oil exploration  
Oil & gas  
Pharmaceuticals  
Power generation  
Pulp & paper  
Steel  
Water/wastewater

### Key Products

Analytical Instruments  
Analytical sample conditioning products & systems  
Chemical injection fittings & valves  
Fluoropolymer chemical delivery fittings, valves & pumps  
High purity gas delivery fittings, valves, regulators & digital flow controllers  
Industrial mass flow meters/controllers  
Permanent no-weld tube fittings  
Precision industrial regulators & flow controllers  
Process control double block & bleeds  
Process control fittings, valves, regulators & manifold valves



## Sealing & Shielding

### Key Markets

Aerospace  
Chemical processing  
Consumer  
Fluid power  
General Industrial  
Information technology  
Life sciences  
Microelectronics  
Military  
Oil & gas  
Power generation  
Renewable energy  
Telecommunications  
Transportation

### Key Products

Dynamic seals  
Elastomeric o-rings  
Electro-medical instrument design & assembly  
EMI shielding  
Extruded & precision-cut, fabricated elastomeric seals  
High temperature metal seals  
Homogeneous & inserted elastomeric shapes  
Medical device fabrication & assembly  
Metal & plastic retained composite seals  
Shielded optical windows  
Silicone tubing & extrusions  
Thermal management  
Vibration dampening

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